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STUDYING THE IMPACT OF URBAN DENSIFICATION ON SOCIAL SUSTAINABILITY: THE CASE OF BIDA BIN AMMAR NEIGHBORHOOD IN AL AIN, UAE

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This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Science in Architectural Engineering

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Declaration of Original Work

I, Lubna Mohammad Ghaffar Shekfa, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this thesis entitled "*Studying the Impact of Urban Densification on Social Sustainability: The Case of Bida Bin Ammar Neighborhood in Al Ain, UAE*", hereby, solemnly declare that this thesis is my own original research work that has been done and prepared by me under the supervision of Dr. Khaled Galal Ahmed, in the College of Architectural Engineering at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my thesis have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this thesis.

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Abstract

As cities under the influence of rapid development, industrialization, modernization, and globalization, a key task for local authorities, urban planners, and residents is to understand what makes a neighborhood socially sustainable. In Al Ain City in the UAE, urban sprawl has been a persistent sustainability problem caused by low urban density and has led to the heavy reliance on private cars. To overcome this problem, urban densification as a sustainable planning approach is recommended. Al Ain 2030 Plan has adopted this approach for redevelopment of Asharej District. This research aims at studying the application of urban densification tools and their impacts on social sustainability in the Bida Bin Ammar neighborhood, Asharej district in Al Ain City that started in 2010. The study highlights the dichotomy of the urban densification approach, where although it is an advocated sustainable solution to limit urban sprawl, but it has its pitfalls. The research answers two main questions: what are the applied urban densification tools in Bida Bin Ammar neighborhood as an example of a neighborhood going under transformation towards higher urban density? and what are the impacts of the application of the urban densification tools on the social sustainability principles in Bida Bin Ammar neighborhood? The research adopts a qualitative case study method utilizing field observation as the primary source of primary data, while the analysis of CAD drawings, census data, Al Ain Plan 2030, land-use plans, and Google Earth maps form a secondary source of data for this study. Based on the results of the study, it is concluded that urban densification has been a prominent method for enhancing social sustainability in Bida Bin Ammar neighborhood but in various degree of success. Some social sustainability principles including mixed use and accessibility have been partially achieved in the study area, while density, mobility, social capital, quality of life, sense of belonging, and safety and security have been weakly achieved. Finally, the results of the research study determined what measures of urban densification succeeded in achieving social sustainability in the study area and what did not work well and why. This will inform decision-makers in the city and maybe in the UAE about the outcomes of the applied urban densification tools, hence, these tools could be revised to ensure that the redevelopment of existing neighborhoods is meeting the social sustainability principles.

Keywords: Urban Densification, Sustainability, Neighborhood, Bida Bin Ammar, Al Ain, UAE.

Title and Abstract (in Arabic)

دراسة تأثير التكثيف العمراني على الاستدامة الاجتماعية: حالة حي بدع بن عمار في العين، الإمارات العربية المتحدة

الملخص

نظرًا لأن المدن تخضع لتأثير التطور السريع والحداثة والعولمة ، فإن المهمة الرئيسية للسلطات المحلية والمخططين الحضريين والسكان هي فهم ما يجعل الحي مستدامًا اجتماعيًا. في مدينة العين .يدولة الإمارات العربية المتحدة ، شكل الامتداد العمرا نيمشكلة مزمنة ناجمة عن انخفاض الكثافة الحضرية والاعتماد الكبير على استخدام السيارات الخاصة. للتغلب على هذه المشكلة ، للتغلب على هذه المشكلة، يوصى بالتكثيف الحضري كنهج تخطيط مستدام. اعتمدت خطة العين 2030 هذا النهج لإعادة تطوير منطقة عشارج. يهدف هذا البحث إلى دراسة تطبيق أدوات التكثيف العمر انيوتأثيرها على الاستدامة الاجتماعية في حي بدع بن عمار بمنطقة عشارج بمدينة العين والتي بدأت منذ عام 2010. تسلط الدراسة الضوء على ثنائية نهج التكثيف العمراني ، حيث أنه حل مستدام للحد من الزحف العمراني ، ولكن له عيوبه. يجيب البحث على سؤالين رئيسيين: ما هي أدوات التكثيف العمراني التي تم تطبيقها في حي بدع بن عمار كمثال لحي يمر بالتحول نحو كثافة عمرانية أعلى؟ وما تأثيرات تطبيق أدوات التكثيف العمراني على مبادئ الاستدامة الاجتماعية في حي بدع بن عمار؟ يتبنى البحث طريقة دراسة الحالة النوعية باستخدام الملاحظة الميدانية كمصدر أساسيللبيانات الأولية ، بينما يشكل تحليلرسومات CAD والتعداد السكاني وخطة العين 2030 وخطط استخدام الأراضي وخرائط Google Earth مصدرًا ثانويًا للبيانات في هذه الدراسة. بناءً على نتائج الدراسة ، استنتج أن التكثيف العمراني كان وسيلة بارزة لتعزيز الاستدامة الاجتماعية في حي بدع بن عمار ولكن بدرجات مختلفة من النجاح. تم تحقيق بعض مبادئ الاستدامة الاجتماعية بما في ذلك مبدأي الاستخدام المختلط وإمكانية الوصول جزئيًا في منطقة الدراسة ، بينما تم تحقيق مبادئ الكثافة والتنقل ورأس المال الاجتماعي ونوعية الحياة والشعور بالانتماء والسلامة والأمن بشكل ضعيف. أخيرًا ، حددت نتائج الدراسة البحثية أي من مقاييس التكثيف العمراني نجحت في تحقيق الاستدامة الاجتماعية في منطقة الدراسة وما لم يعمل بشكل جيد ولماذا. سيؤدي ذلك إلى إعلام صانعي القرار في المدينة -وربما في الإمارات العربية المتحدة- بنتائج أدوات التكثيف العمراني المطبقة ، وبالتالي يمكن مراجعة هذه الأدوات لضمان أن إعادة تطوير الأحياء الحالية تلبي مبادئ الاستدامة الاجتماعية.

مفاهيم البحث الرئيسية: تكثيف حضري، استدامة، حي، بدع بن عمار، العين، الإمارات العربية المتحدة.

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Dedication

To my beloved parents and family

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List of Abbreviations

AACM	Al Ain City Municipality
ADU	Accessory Dwelling Unit
CAD	Computer Aided Drawing
CBD	Central Business District
CO_2	Carbon Dioxide
COVID-19	Corona Virus Disease - 2019
DPH	Dwelling Units Per Hectare
FAR	Floor Area Ratio
HPH	House Per Hectare
MXD	Mixed-Use Development
PPH	Person Per Hectare
TOD	Transit Oriented Development
UAE	United Arab Emirates
UAEU	United Arab Emirates University

Chapter 1: Introduction

1.1 Sustainable Development

As said within the research of Kruger (2017), the foremost prevalent concept of sustainable development was initiated by the World Commission within the 1987 Brundtland Report. Sustainable development was explained by the Commission as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". The notion gives the premise for the enhancement and development of the common objectives of social, economic, environmental, and safety and security. The key principle of sustainable improvement is the integrated combination of environmental, social, and economic aspects throughout the decision making approaches in order to cross toward development that is sustainable, and free of fragmentation (Emas, 2015). Sustainable development depends on the triple bottom line concept, which suggests the equilibrium between three bases of sustainability (environmental, social, and fiscal). Each pillar of sustainability should take into consideration the aspects of other pillars to attain the balance between them, which is not an easy process to achieve (Klarin, 2018). On the other hand, the term "sustainability" or "sustainable development" would show that environmental aspects have created a more noteworthy volume of composing in the research studies, whereas little work has been done on the social side of sustainability (Pitarch-Garrido, 2018).

1.2 Definition of Social Sustainability

According to Zainol, Isa, Sakip, and Azmi (2018), the word 'social' was integrated late into debates on developing sustainability. They also indicated that social sustainability refers to places where people want to live and work, now and in the

future. As per What is social sustainability? (2020), social sustainability is “a process for creating sustainable successful places that promote wellbeing, by understanding what people need from the places they live and work. Social sustainability combines design of the physical realm with design of the social world – infrastructure to support social and cultural life, social amenities, systems for citizen engagement, and space for people and places to evolve.” As mentioned by Eizenberg and Jabareen (2017), social sustainability looks to improve the safety and security of individuals regardless of their origin, culture, color, or socio-economic status, through the enhancement of social, economic and environmental policies. As claimed by Bramley and Power (2009), there are two recognizable concepts of social supportability. The first one is social equity access to various services, job opportunities, and housing affordability. The second concept is associated with the sustainability of the neighborhood itself. This is through various aspects such as people interaction, community participation, sense of belonging, and safety and security. Furthermore, Karuppannan and Sivam (2011), mentioned that the social sustainability of a community is affected by the urban form because the site design can influence positively or negatively people's behavior. Thus, an integration of physical and social designs needs to be considered to achieve a social and environmentally sustainable neighborhood.

1.3 Principles and Indicators of Socially Sustainable Community

As explained by (Zainol et al., 2018), social sustainability is associated with urban planning and design principles, such as compactness, density, mixed-use, sustainable transport, and greening. It is linked directly to physical factors through the provision of the needed facilities for all types of people, such as the provision of attractive public realms that improves the quality of local environmental. Besides,

(Zainol et al., 2018) mentioned that among the principles that influence the physical factors of social sustainability are accessibility, pedestrian-friendly, social interaction, physical activity, safety, health, and a sense of belonging. Generally, a city's vitality is tied to its human scale, diversity and quality of public space, as clarified by Karuppannan and Sivam (2011). In addition, there are several elements that should be incorporated in design to make residential development socially sustainable, such as pedestrian friendly neighborhoods, mixed land use, provision of social infrastructure and recreational facilities for all age groups, accessibility to public realm, ability to fulfil everyone needs irrespective of age and maximization of community participants. Indeed, social sustainability is a process that addresses the relationship between society and the built environment and the quality of life in neighborhood setting (Karuppannan & Sivam, 2011). Several social sustainability principles that can be affected by urban densification area going to be studied in this research as per the following.

1.3.1 Density

Dave (2011) explained, higher densities in cities provide good accessibility to facilities within walking distances and may make access to social services easier. Thus, higher densities enhance social sustainability. According to Grosvenor and O'Neill (2014), density is an indicator of urban form. For Dave (2011), density is explained as the ratio of population and/or of built space to a given area of land. Density of people and density of buildings are correlated because an increase in the density in one leads to an increase of density in the other. In addition, Dave clarified that higher density means a higher ratio of buildings to a given land area. Higher density affects social, economic, and environmental conditions because it utilizes the land area more efficiently and saves rare resources. The number of people per hectare does not clarify the physical form of the buildings. Therefore, density is difficult to be represented by

one measure. Thus, several measures such as built form, a mix of uses, and sociodemographic characteristics of a neighborhood need to interact with density to assess the influence on sustainability. Moreover, as claimed by Barton (2000), higher density development can contribute positively to the development strategy of transport corridors and nodes by increasing the accessibility to public transport, providing local jobs, services, and facilities. Besides, Barton clarified that higher density is associated with less travel distances. It is proposed that a critical ward level gross population density of 40 to 50 persons per hectare, at which travel distance is lowest (Barton, 2000).

1.3.2 Accessibility

For Chan and Lee (2008), accessibility contributes to enhancing social sustainability. Accessibility is associated with the presence of various services that meets the resident's needs and allow for social equity. Besides, accessibility has positive impacts and helps in reducing the travel distance and encourages the place to be more vital because residents who are near to the services and facilities, are living a more healthy lifestyle, and would like to travel on foot instead of using cars. Therefore, measuring spatial equity can be done by the distance from the place of residence to public services (Pitarch-Garrido, 2018). Chan and Lee (2008), mentioned that people tend to live in a place job opportunities nearby, and various facilities that can serve their daily needs without depending on cars. Besides, Chan and Lee clarified that proper access to a specific place is essential for residents to let them easily approach their daily life services, and to enhance the freedom of movement from place to place as a basic human right. Hence, the catchment area to the nearest daily services and facilities such as retail, open spaces, hospitals, primary school, offices, and banks need

to be considered in designing sustainable communities (Chan & Lee, 2008). According to Barton (2000) local catchment areas for pedestrian access to local services can be determined by threshold walking times (5 or 10 minutes) or distance (400-800 m). As per Barton (2000) walking to local facilities is affected by both user and use. Users are prepared to walk further for a higher quality of service such as 300-400 m to a bus stop but 600-800 m to a light rail station. In British and Dutch new towns, American TODs, 400 or 500 m standard is widely applied to access local neighborhood facilities and bus services. The distance recommended for primary schools is 400-600 m, for local shops 400-800 m, and parks and playing fields 800-1000 m. See Figure 1 that shows the catchment area to nearest daily use. Moreover, as explained by Barton (2000) another consideration for good accessibility is to allow for proper matching of local employment needs to local job opportunities, and the employment uses to be approximate to residential areas. Furthermore, as clarified by Barton (2000), to reduce the reliance on car use, and the amount of parking for development, proper access to public transport with the provision of walking and cycling networks are required to encourage sustainable and friendly modes of movement.

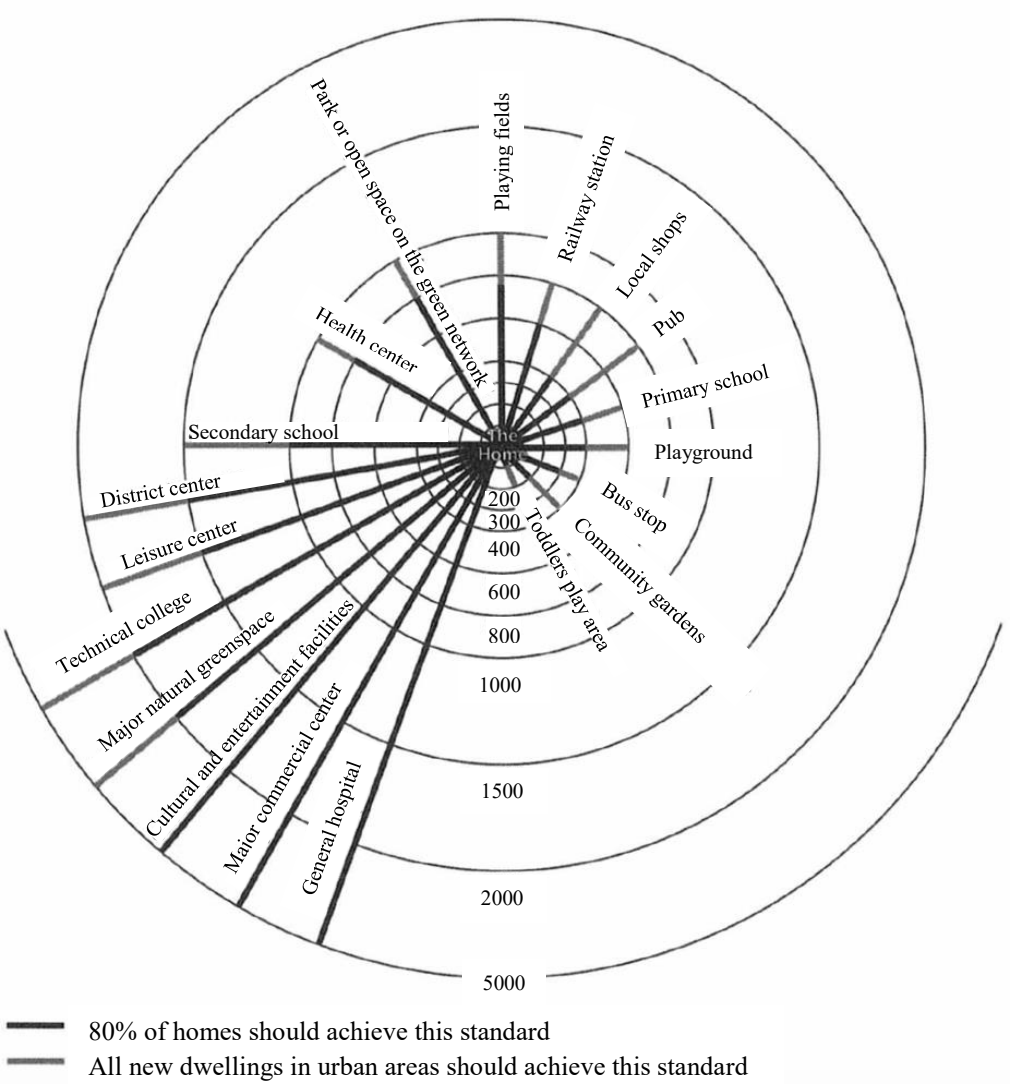


Figure 1: Standards for Accessibility to Local Facilities (Barton, 2000).

1.3.3 Mobility

With reference to the study of Jakeel (2017), social sustainability can be implemented through the provision of equal and easy access to various services and facilities, and modes of mobility. Besides, as mentioned by Transport and sustainability: the social pillar (2003), walking, cycling, and public transport are real options for accessing the services of everyday life. Thus, sustainable transport policies must achieve people's needs for access to services, education, health services,

employment, and leisure activities. Furthermore, as per Barton (2000), to encourage walkability and cycling in the neighborhood instead of relying on car use, several design principles need to be considered, such as traffic-calmed streets, permeability, variety of streetscape, effective surveillance, and the creation of activity hubs to create a sense of urban vitality in the community. Moreover, as claimed by Barton (2000), it is recommended to have a minimum width of 1.5 m, preferably 2.0 m for cycle lanes. Besides, cyclists and pedestrians can share the same route, but more safety measures should be considered to avoid conflict with the more vulnerable pedestrians. Additionally, according to Barton (2000), local movement plans can reduce social exclusion. Also, the roads, paths and squares allow for movement and the network of social connections and activities. As indicated by Shirazi and Falahat (2012), with low density and with facilities that are not within a walkable distance is unsafe to walk and increases the reliance on car use. Thus, walkability and transport accessibility participate in improving quality of life (Han, Liang, Hara, Uwasu, & Dong, 2016). On the other hand, as clarified by Barton (2000), high streets can facilitate the connections by cycle, fast efficient public transport, bus/tram and foot to the rest of the urban area, where the car use can be permitted but ‘calmed’.

1.3.4 Mixed-Use

As per Bahadure and Kotharkar (2012), the physical environment by mixed land-use development enhances social sustainability. Mixed-use is an appropriate mix of different land uses in an area, where a variety of living activities like living, work, shop, and leisure are nearby. Also, Bahadure and Kotharkar clarified that the mixed-use area is safe and accessible because it promotes walkability and social inclusion. As argued by Kruger (2017), mixed-use contributes to enhancing sustainable urban

form by allowing people to walk to their destinations. This is through the provision of the multi-family, and single-family housing, and business facilities in an approximate distance. According to Barton (2000), a sustainable community allow people to walk or cycle to their destination by traveling less to reduce relying on car use and pollution, through the provision of facilities and services. According to Chan and Lee (2008), the provision of job opportunities allows for social interaction, provides income to the individuals, and enhances the feeling of social well-being of people. Mixed-use places encourage walking, bike, and mass transit use due to the proximity of one amenity to another. Jacobs discussed that mixed-use can make a neighborhood safer because the same block can contain a mix of uses which allow for the presence of people in different periods during the day in some cases, for 24 hours. This can contribute to achieving "the eyes on the street" which can provide more security in sprawling areas characterized by isolated areas with no activities on the street (Pendola, 2017). Besides, mixed-use communities provide more dwelling diversity such as apartment towers, infill houses, stacked apartments, attached houses (Urban Densification, 2017).

1.3.5 Social Capital

As mentioned by Yoo and Lee (2016), social sustainability, social capital, and the neighborhood built environment are logically connected. Social capital exists through interactions and in networks among people. Thus, it is related to physical factors, and therefore, space for interaction is needed, and this indicates the significance of the environment in the process of developing social capital in the neighborhood. Many studies have found a significant relationship between social capital and the key concepts in achieving social sustainability in the built environment

such as meeting places, a mix of housing types, sense of belonging to a place, equitable access to services, and mix of land-use (Yoo & Lee, 2016). As per Garrigos-Simon, Botella-Carrubi, and Gonzalez-Cruz (2018), social bonds and norms are the components of social capital and the basis of sustainable livelihoods. For Barton (2000), social capital is associated with the network of personal relationships that provides support and meaning to people's lives. It adopts both the casual daily meetings and sense of belonging that provide shape to life and a source of friendship. As mentioned by Chan and Lee (2008), social interaction is 'the basic process in the formation of both human nature and the social order'. Without social interaction, people living in a given area can only be described as a group of individuals living separate lives, with little sense of community or place attachment. Also, the presence of different public facilities is vital to society, such as medical centers, sports facilities, and community centers that provide various leisure activities. Besides, open spaces and green areas provide buffer zones in crowded areas to facilitate social gatherings and public interaction. As referenced by Dave (2011), social sustainability is associated with the concept of social interaction and the concept of community spirit. Social cohesion which is the ongoing integration of behaviors of residents in a given neighborhood is affected by different social settings such as individuals, families, and communities. On the other hand, Dave (2011) mentioned in his research study that there are contradictory arguments about the relationship between high density and social interaction. Furthermore, Dave indicated in his research that high density enhances social interaction, where other researches show that overcrowding has negative impacts on social interaction.

1.3.6 Quality of Life

Quality of life consists of indicators and multiple life domains that can measure the current situations of people's lives. It is an interaction between the external conditions of an individual's life and the internal perception of those conditions (Zhang & Zhang, 2018). As claimed by Popovic and Kraslawski (2018), quality of life is an important aspect to achieve social sustainability. It consists of wellbeing, security, physical environment, community improvement, and natural assets and services. Besides, the presence of local services reduces the need to travel and the use of a car and encourages walkability. It improves the quality of the environment, and makes urban areas more attractive for people to live, work, study, and spend leisure time. Also, the provision of energy-efficiency strategies in buildings that reduce heat loss from buildings is required to enhance the quality of the environment (Barton, 2000). On the other hand, as explained by Barton (2000), in urban neighborhoods, planning for sustainable development must promote environmentally-friendly forms of industrial and agricultural production that can encourage waste recycling systems. Besides, the provision of local food sources such as market gardens, and a case where people can grow their fruit and vegetables in gardens, and city farms, encourage eating more fresh fruit and vegetables and preventing chronic diseases. Thus, enhance the quality of life and contribute to the development of the community to practice sustainable lifestyles (Barton, 2000).

1.3.7 Sense of Belonging: Identity and Community Spirit

The sense of belonging is associated with the presence of social interaction, and it is a significant factor to measure the sustainability of the community. Since social capital is interrelated with social sustainability, it enhances the sense of

belonging to the community and helps people to be attached to their community, and feel secure (Yoo & Lee, 2016). As mentioned by Menconi, Artemi, Borghi, and Grohmann (2018), the sense of belonging is a variable of perception that comes from the combination of features that a community identifies in the place in which it lives. It is related to the everyday life of people. A sense of belonging develops with human identity and has a time horizon that goes from the memories in the past to future desires. It consists of several parameters such as the period of residence, the physical dimensions, and the geographic distance from home, the individuals' sensibility for the environmental values, the activities that take place in it, and the events that happen over a lifetime. Moreover, Chan and Lee (2008) argue that heritage should be preserved in a proper way for the enjoyment of future generations. Local characteristics of an area such as daily activities, customs, and ways of living should be respected and conserved through urban design, to enhance the feeling of residents that they are part of the community. Additionally, to have unique characteristics, distinguishing each community from neighboring places, planning policy should take into consideration that development should be responsive to the particular context (land), landscape, geological, and microclimate conditions (Barton, 2000). To enhance the achievement of the sense of belonging, and the people's perception of a locality, each place should have its character different from other places, by applying clear boundaries. Many studies display the degree to which personalized image of neighborhood, depending on what residents feel is home terrain, and identified by landmarks. This can be achieved by allowing residents and visitors to be able to find their way around, with key nodes marked by distinctive public spaces, higher buildings, vistas, and public art. Besides, recent design guidelines are concentrating on the responsiveness to local culture in terms of materials, built form, landscape, urban

morphology, and to design the space that is physically distinctive where people will choose to be pedestrians (Barton, 2000). Finally, as per Barton (2000), the real appreciation of place does not come from the person in the car, but from people walking, cycling and meeting, enjoying the sights, sounds, smells, touch, and history of the place.

1.3.8 Safety and Security

Chan and Lee (2008) clarified in their research study, security is an essential component that needs to be achieved in every neighborhood to be socially sustainable. Residents need to know what is going around their houses and like to have the spaces under their surveillance to feel secured. Furthermore, fear of accidents is the biggest barrier to walking and cycling, especially for children. 'Community Safety' is now a significant direction amongst social work professionals (Barton, 2000). Moreover, when there is an opportunity for people to walk, and when there is the chance to have the notion of 'eyes on the street' the fear of violence is reduced, and streets become safer for people to walk. Thus, recently urban designers are highlighting the importance of the convenience of local facilities, with effective 'natural' surveillance of streets and walkways to create pleasant places for people to go to (Barton, 2000).

1.3.9 Community Participation

Public participation is an important aspect of social sustainability. In order to meet the local needs of the residents of a community, their participation in the urban design procedure is required (Chan & Lee, 2008). As claimed by Atanda and Öztürk (2018), participatory design is the engagement of the residents in the design programs as a social process that can enhance the role of society. Therefore, as per Karuppannan

and Sivam (2011), the participation of residents in the design of their communities, and the ability to achieve their desires is important factor for a socially sustainable community.

1.4 Urban Sprawl as an Ongoing Problem in UAE's Urban Communities

According to Bhatta, Saraswati, and Bandyopadhyay (2010), urban sprawl is unplanned growth of the community without taking into consideration the impacts of this unarranged urban growth. It is an unsustainable and unplanned procedure of growth described by the inefficient utilization of resources. For Chin (2002), sprawl is a matter of degree, not an absolute form. With regard to the urban form, urban sprawl goes against the idea of the compact city that is associated with high density, centralized development, and a spatial mix of functions. Urban sprawl can also be defined through land-use patterns. Besides, the impacts of sprawl can be considered as a different way of definition. Thus, it is not easy to differentiate sprawl from other forms. However, the impacts of sprawl make the sprawl unwanted not the form itself. Moreover, urban sprawl is associated with the notion of low density, and poor accessibility via related land uses, and the lack of functional open spaces. In addition, urban sprawl is associated with low density and car-dependent development, which spreads out over a large area of land, creating large distances and segregation between homes, and community facilities (Urban sprawl, 2014). On the other hand, as mentioned by Chin (2002), urban sprawl is a negative urban form that reflects un-aesthetic development, poor access to services especially for elderly that have limited mobility. Besides, it increases trip lengths, congestion, and fuel consumption due to low densities, and car use. Also, urban sprawl causes loss of agricultural land and open space. Accordingly, growth management policies are trying to encounter these issues by adopting a more compact urban form and trying to set physical limits to growth

through growth boundaries and land preservation. Therefore, as clarified by (Bhatta, et al., 2010), urban planners and city administrators need to have a clear distinction between sprawl and compact development to tackle the problems associated with urban sprawl. Finally, urban sprawl, which is correlated with low density and reliance on car use is a common problem in Al Ain City in the UAE. Several urban planning theories recommended urban densification to be a solution to tackle the problems associated with sprawl. This research is going to study the application of urban densification tools, and its impacts on the social sustainability principles in the Bida Bin Ammar neighborhood in Asharej district in Al Ain city. The research study aims to explore the dichotomy of urban densification, where although according to various urban theories, urban densification is a sustainable solution, to limit the urban sprawl, but still it has its pitfalls that should be considered as a challenge.

1.5 Negative Impacts of Urban Sprawl on Social Sustainability

For Brueckner and Largey (2008), urban sprawl that is characterized by low-density development affects negatively on the level of social interaction, and thus, weakens social capital. Besides, the social lives of people in such low-density developments are adversely affected because residents don’t have neighbors that live as close, which means that they won’t stay as social as they should (Rinkesh, 2016). Moreover, as argued by Jane Jacobs, who wrote the book "The Death and Life of Great American Cities" in 1961, urban sprawl is associated with the lack of walkable environments due to the long distances that people need to travel by cars to reach to their destinations. Also, the design of land use to accommodate auto traffic makes walking neither unpleasant nor impossible (Pendola, 2017). Furthermore, as per Urban sprawl (2014), urban sprawl affects negatively on people and the environment. It causes higher water and air pollution, loss of agricultural capacity, and consumes a lot

of acres of farmland, increases flooding, and decreases the social capital, and leads to the loss of natural habitats, wildlife, and open space. Also, it increases traffic congestion and car dependency. Besides, it has harmful effects on human health, including higher rates of obesity, high blood pressure, hypertension, and chronic diseases (Urban sprawl, 2014).

1.6 Urban Densification as a Social Sustainability Solution for Urban Sprawling

As mentioned by Weinschenk (2017), urban densification contributes to achieving more sustainable and environmentally friendly cities, through the application of various densification tools such as increasing the number of dwelling units, mixed-use spaces, filling in vacant lots with shared spaces. Moreover, the application of urban densification tools can provide a solution to climate change because electricity, water, and other municipal services can be provided efficiently to more people in a small amount of space by using fewer resources and less energy. In addition, according to HaskoningDHV (2013), urban densification supports public transport, improves access to social and commercial facilities, and employment. Also, HaskoningDHV (2013) clarified that urban densification makes neighborhoods safer and enhances surveillance. It can be implemented in places that have good access to infrastructure, social services, and public transportation. Furthermore, as argued by Attia (2015), urban densification is a strategy that goes against car-based urban sprawl that occurred in various cities in the second half of the 20th century.

1.6.1 Urban Density as an Influential Measure of Social Sustainability

According to HaskoningDHV (2013), in planning and urban design, the concept of density is applied to estimate and promote the use of land. Density is "the population or number of residential units divided by the land area". Additionally, gross

density can be assigned by "dividing the total population/residential units of an identifiable development site by the total land area of the development site, covers all land used for different uses such as transportation, education, industry, commerce, and parks but excludes land extensive areas such as agricultural land and nature reserves/parks areas". On the other hand, net Density is identified by "dividing the population/residential units by the total residential land only within the development site, excluding public roads and public open space, includes only the area allocated for residential uses and internal roads". See Figure 2. Moreover, the significance of density measures are related to the ability to use them to assess the intensity of built form on a specific site, calculate population densities, model the impacts of development standards, and monitor how well development is proceeding versus the original vision (HaskoningDHV, 2013). As mentioned by Clarke and Callaghan (2007), net density measurement is applied in London by its spatial planning policy. Furthermore, "measuring the total floor area of a building or the gross density are other measures of density that can be identified as the Floor Area Ratio (FAR)". FAR gives significant data about a specific area such as the urban volume of a building as a variable of resultant floor area relative to the site footprint". In addition, "dwellings per hectare' (du/ha) is an estimation of housing density that can be utilized to supply a generic metric of density that empowers a uniform type of housing that subsequently fails to recognize the demographic complexity of modern society" (Clarke & Callaghan, 2007). See Figure 3 for more details.

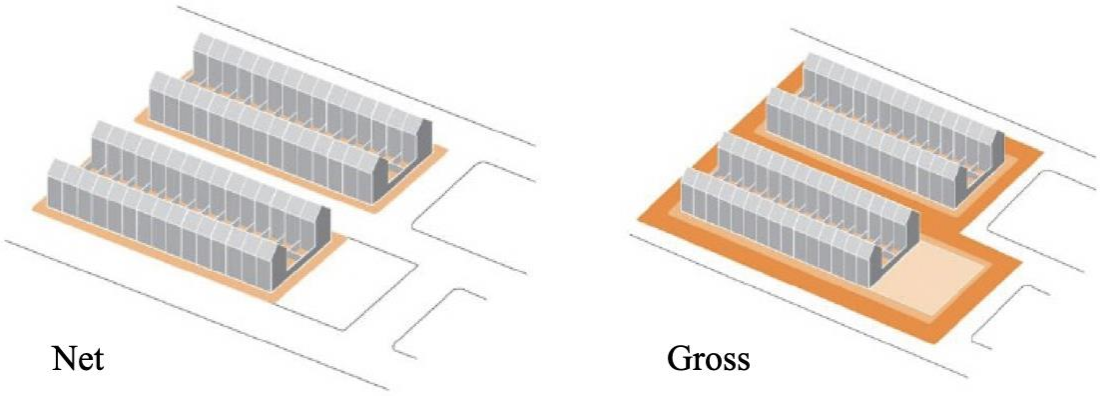


Figure 2: Gross and Net Density (HaskoningDHV, 2013).

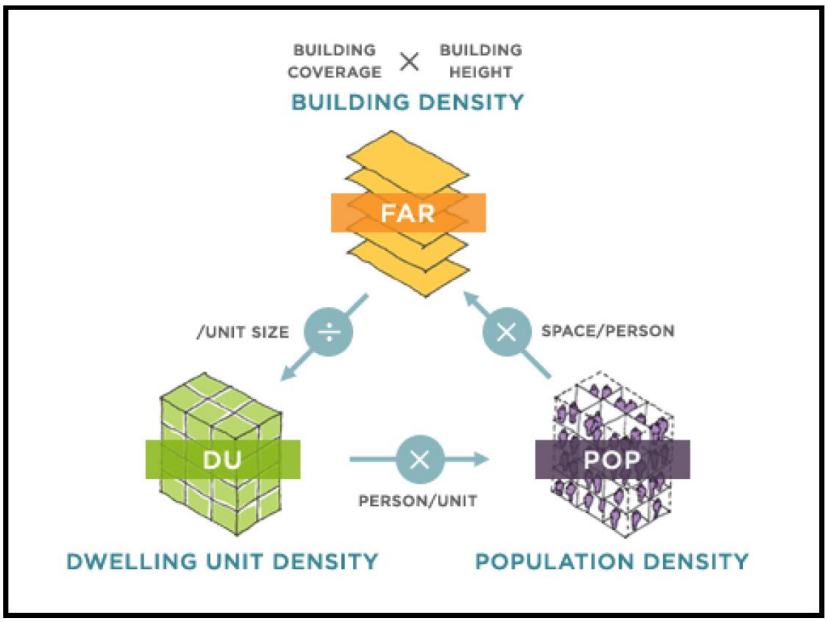


Figure 3: Density Measurements (Kruger, 2017).

Differentiating between quantitative (measured) and qualitative (perceived) density is not an easy task (HaskoningDHV, 2013). As clarified by Chin (2002), countries have different standards for density relying on their culture. In U.S. low density is the development of two to four houses per acre where in the U.K. low-density compromises eight to twelve houses per acre (not less than this). For Chin

(2002), parameters that are used for the numerator and denominator of the density calculation vary. Thus, the perception of low-density varies depending on these parameters. Low-density is not usually quantified in the definition of sprawl. Also, it is explained that the correlation between the number of people living in an area and a given land area is expressing the relation between density and sprawl. Residential units are used for the numerator, where the definition of the land area is used for the denominator. In recent debates, density is a concern regarding the urban future, due to the conflict between the private and public interests concerning the density of urban living. This conflict knows as 'Tragedy of the Commons'. Many people prefer to live in less dense urban forms, ending to sprawling, which goes against the notion of sustainable urban development. Furthermore, density is not the only principle of sustainability. Sustainability aims to achieve a balance between economic, environmental, and social aspects. Thus, the relationship between the social, economic, and environmental results generated by different density levels should be considered. However, there are also conflicts between environmental and social aspects of densification. Besides, as per Densification beyond the city center: urban transformation against sprawl (2019), lower-income people are affected by densification, because they may be pushed away from the central areas, with lower opportunities to access inner-city jobs. Usually, the environmentally positive densification causes negative social issues such as gentrification that decrease the social mix (Densification beyond the city centre: urban transformation against sprawl, 2019). The advantages and disadvantages associated with both high and low density residential development are illustrated in Figure 4.

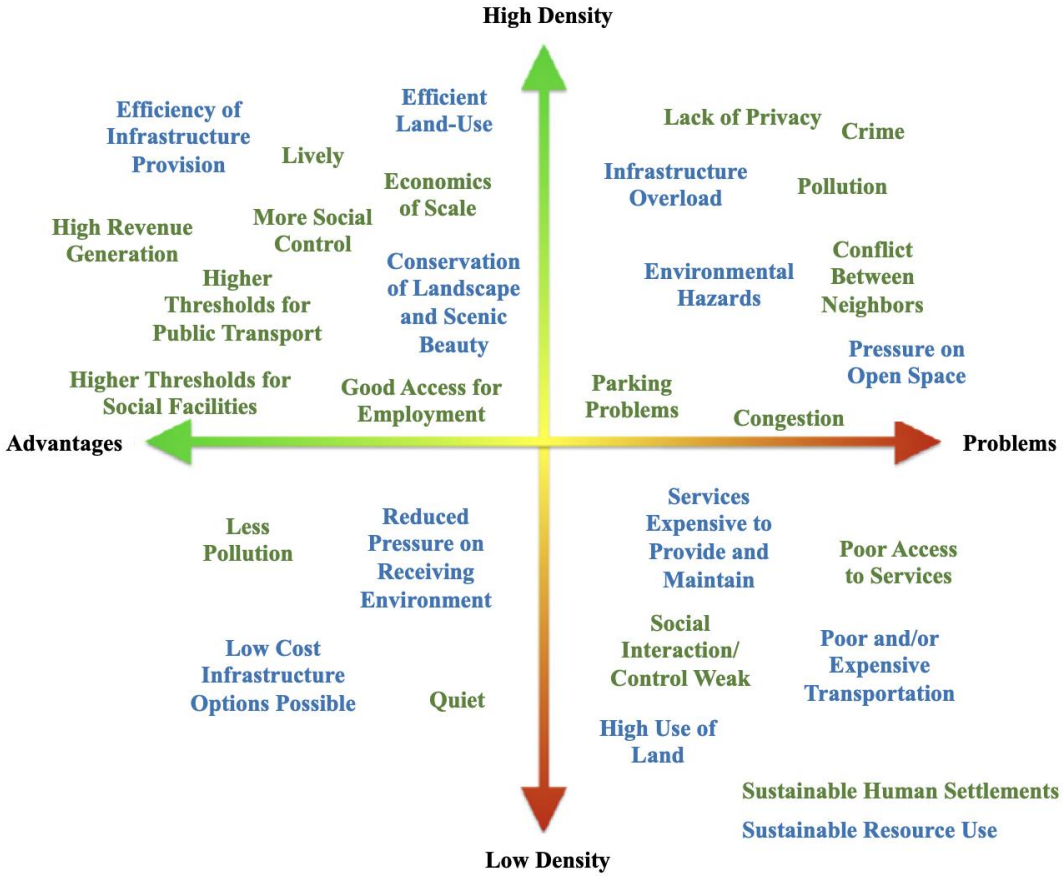


Figure 4: Density Advantages and Disadvantages (HaskoningDHV, 2013).

1.7 Bida Bin Ammar Urban Densification Plan

According to Plan Al Ain 2030 (2009), the Urban Structure Framework Plan provides conceptual solutions to shape the growth of Al Ain city over the next quarter century. By 2030, Asharej will join the Central District in housing the bulk of the population of Al Ain. New Emirati neighborhoods are mostly developed at lower densities but with proximate commercial streets that combine street level retail with higher density housing. The plan shows areas appropriate for this development while respecting environmental and social considerations, including sprawl, access to transport and amenities. Figure 5 demonstrates the Urban Structure Framework Plan for Al Ain Plan 2030, and highlights the location of Bida Bin Ammar neighborhood

in Asharej district.

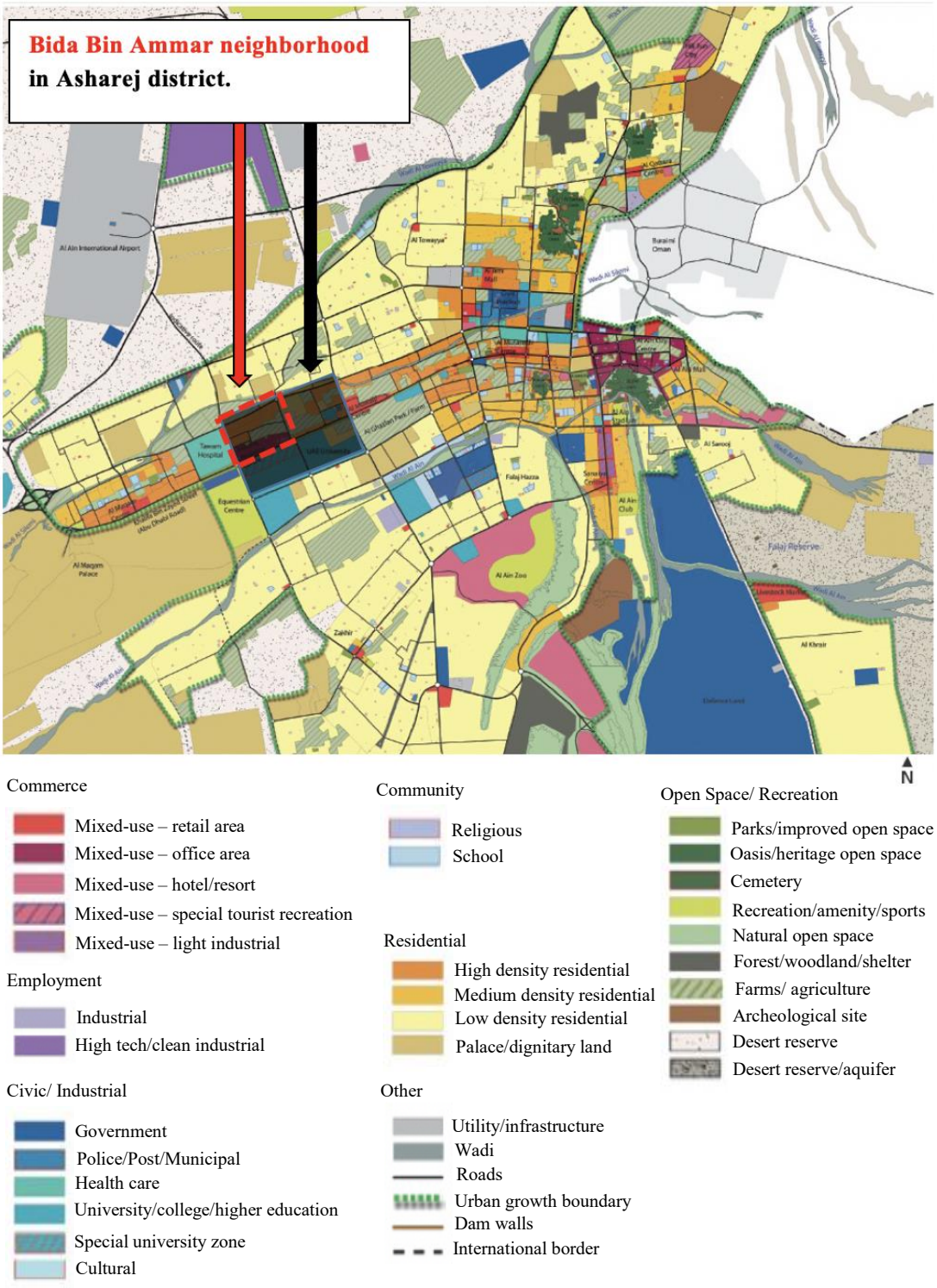


Figure 5: Land-Use Framework Plan for Al Ain City/ Location of the Study Area (Plan Al Ain 2030, 2009).

1.8 Research Questions

1. What are the applied urban densification tools in Bida Bin Ammar neighborhood as an example of neighborhoods going under transformation towards urban densification?
2. What are the impacts of the application of the urban densification tools on the social sustainability principles in Bida Bin Ammar neighborhood?

1.9 Research Objectives

1. Investigate the applied urban densification tools in Bida Bin Ammar neighborhood.
2. Identify social sustainability principles and indicators on the urban community level.
3. Explore the impacts of the applied tools of urban densification in Bida Bin Ammar neighborhood on social sustainability.
4. Determine the global positive and negative impacts of urban densification on social sustainability.
5. Identify the measures and tools of urban densification through exploring urban densification implementation policies and strategies to assess and guide existing development policies to achieve social sustainability.

1.10 Research Structure

Figure 6 demonstrates the research structure and stages. Each stage contains various elements that combine to shape the research design. Several research methods are used in this study to help in investigating the objectives of the research and answering the research questions. These methods are demonstrated in the following chapter, which is the research methodology.

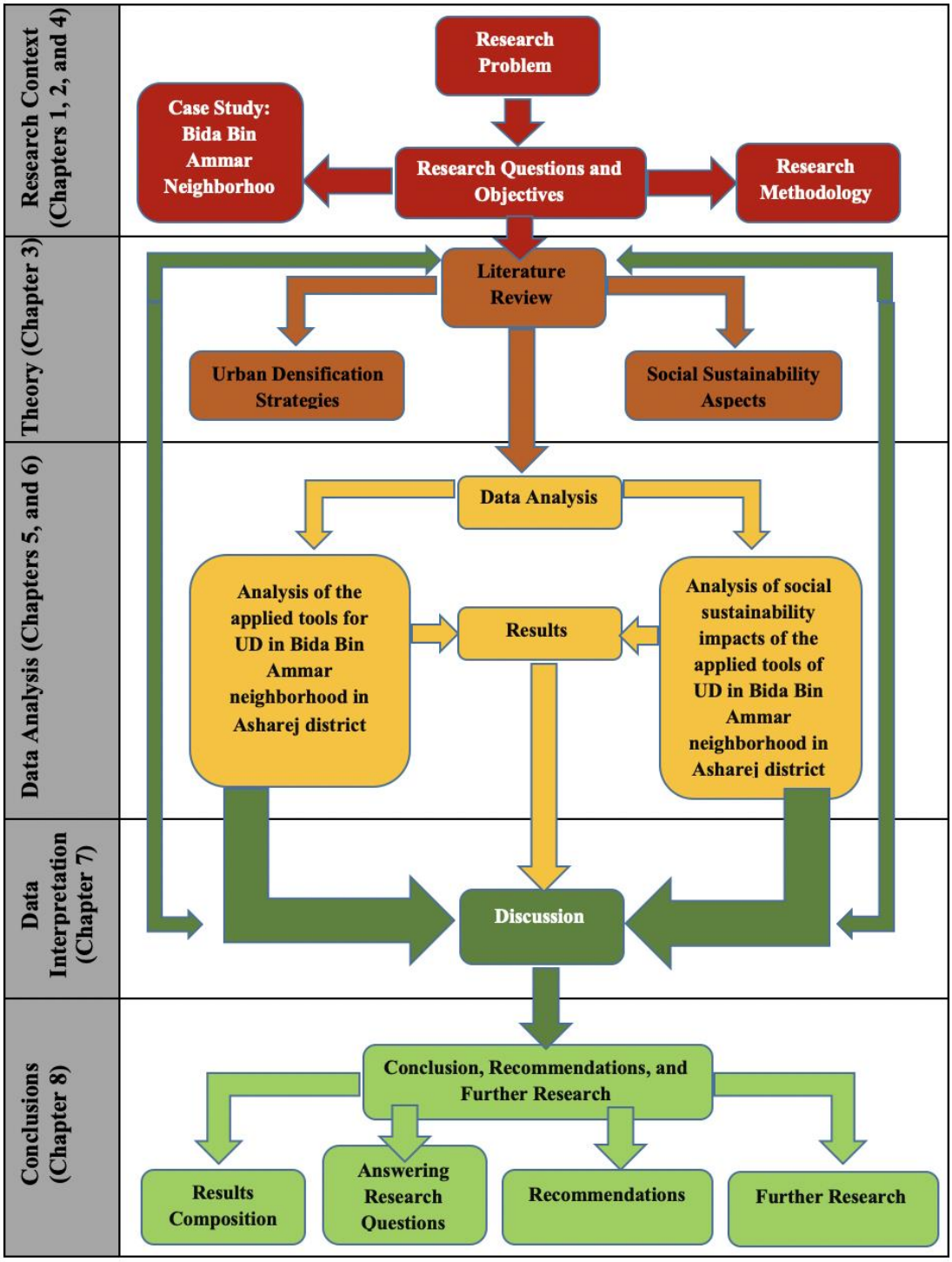


Figure 6: Research Structure and Design.

Chapter 2: Methodology

2.1 Introduction

This research study adopts a qualitative case study approach where relevant literature is reviewed to discuss in the first part of the thesis urban sprawl as an emerging problem. Then, it is suggested that urban densification is a sustainable solution to urban sprawl. Moreover, the study highlights on the dichotomy of urban densification, where although according to various urban theories it is a sustainable solution to limit urban sprawl, but still it has its pitfalls that should be considered as a challenge. This research is conducted in the context of Bida Bin Ammar neighborhood in Asharej district in Al Ain city in UAE. The main objective of the study is to explore the urban densification tools that are applied in the Bida Bin Ammar neighborhood. Also, the research aims to investigate the impacts of the application of urban densification tools on social sustainability principles in the study area as an example of a neighborhood that is going under transformation towards being an urban densified neighborhood.

2.2 Research Design

As mentioned by Nkwanyana (2015), a research design is “a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings”. Besides, the research design is a strategy that describes how, where, and when data will be collected and analyzed. The research design for this study is mainly descriptive, or explanatory. The reason for using a descriptive design is to help in answering questions on what the density value target in Asharej district is, and what are the applied urban densification tools in Bida Bin Ammar neighborhood in Asharej. Thus, a descriptive research strategy is used to encounter the overall

objectives of this study and to answer the main research question. Furthermore, to determine the impact of urban densification as a sustainable solution strategy for urban sprawl, exploratory research is applied. In one hand, explorative research makes one understand the research topic better and specifies the related key factors of it. On the other hand, evaluative research is important to understand the research question and helps in discussing the impacts or influences of policies and its implementation. Besides, the basis of literature related to planning and design can be clarified through case study research, which is an important assessment in specifying the impacts and outputs of densification. Detailed analysis assists in studying the urban densification tools that were applied in the Bida Bin Ammar neighborhood in Asharej district as a chosen case study. Also, it allows for a wider understanding of the urban densification tools such as infill development and its consequences on communities (Barger, 2016). This research adopts a qualitative case study approach. This qualitative-based study "ascribes to the naturalist worldview, a philosophical paradigm that aims to understand the world through the observation, description, and interpretation of experiences of a group of people or context" (Salkind, 2010). Qualitative data depends on opinions, feelings and personal experience rather than generating results in numerical form (Ladden, 2007). Besides, it is an approach where a researcher is using methods such as participant observation or case studies which result in a narrative or descriptive view of a setting or practice. Also, qualitative research is *"*a systematic subjective approach used to describe life experiences and situations to give them meaning*"* (Nkwanyana, 2015). As stated by More (2017) qualitative research helps the researchers to be an observer in the world, and allow them to study things in their natural settings and try to make sense of, or phenomena in terms of the meanings people bring to them, through field notes, photographs, recordings, and memos to the

self. Thus, qualitative data analysis helps the researchers to develop their own theory from the data that has been analyzed. Although qualitative research methods are inductive because the researcher can generate theories or hypotheses, interpretations, and conceptualizations from details provided by participant observation. On the other hand, there is a fact that researchers cannot set aside their experiences, perceptions, and biases, and thus they cannot show themselves objective bystanders to the research. The qualitative approach provides a lens to investigate the urban densification tools that were applied in Bida Bin Ammar neighborhood that is going under transformation towards being an urban densified neighborhood, and its social sustainability consequences. Moreover, there are five strategies of inquiry in qualitative research which are, narratives, phenomenological studies, grounded theory studies, ethnographies, and case studies. The researcher has chosen the case study method to be a strategy applied in qualitative research. Also, there are six stages instilled in each research design: the first stage is philosophical or theoretical perspectives, the second stage is an introduction to a study, which contains the objective and research questions, the third stage is data collection, the fourth stage is related to data analysis, the fifth stage is report writing, and the final stage is the check on the quality standards (More, 2017).

2.3 Case Study Method

According to Yin (1984), the case study research method is “An empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used.” A single-case or multiple-case design can be chosen by the researcher as per the subject of the research question. Also, as mentioned by Zainal (2007) testing the data within a certain geographical context can be done

through the case study method. It allows for a close examination of data on a small area or a very limited number of individuals according to the subject of the study. Moreover, the contemporary real-life phenomenon through detailed contextual analysis of a limited number of situations, and their relationships can be discovered by the researcher through the case study method. For example, where situations are limited to a single occurrence, single-case design can be adopted especially for social studies such as the ones that studied the consequences of the collapse of Highland Towers in Kuala Lumpur in the 1990s or the impacts of the tsunami in Acheh in 2004. On the other hand, the inability to generalize a conclusion from the research results is a pitfall of a single-case design especially when the cases are rare. Triangulating the study with other methods is a tool to overcome this pitfall and ensure the validity of the process. However, a single-case study of Bida Bin Ammar neighborhood in Asharej district in Al Ain city in UAE has been chosen to study the urban densification tools and its impacts on social sustainability principles.

2.4 Investigation Tools

The procedure of data collection can be done through (Ladden, 2007) the primary data examination, and the secondary data examination.

2.4.1 Primary Data

As stated by Nkwanyana (2015), answering the research questions can be done through the tool of observation that helps the researcher to collect required data. Field observations are a primary source of information that allow the researcher to document a particular setting through a specific behavior. Observations can be done by taking notes of behavior, photos and determining the area under study. Field notes can be collected by the researcher through observation as a participant, or as an observer. As

claimed by More (2017), the pros of data collection through the observation tool is that uncommon features can be noticed. On the other hand, the pitfall is that a researcher may not have proper proficiency in observation to collect data. Field observation is a primary source of data that is applied in this study to investigate the urban densification strategy and the social sustainability consequences of urban densification strategy in Bida Bin Ammar neighborhood in Asharej district. Besides, for this study, photos are also used to pick up and describe some of the changes in the spatial character of the Bidaa Bin Ammar neighborhood over the past ten years.

2.4.2 Secondary Data

According to Ladden (2007), the analysis of pre-existing data is known as secondary sources of data, which allows for documentation and review of primary research. The importance of using secondary sources of data is that it forms the base of research, and allows for new topics of research. Besides, it can provide ideas for different topics for research. Also, it may be a source of method-based or theory based ideas. Moreover, it can play a role in supporting the research topic, and strengthen its ideas. The secondary data for this study was obtained from the UAEU library. Books, journals, research thesis, and dissertations were analyzed to grasp a thorough understanding of the topic. These secondary sources of data documented a number of theories and detailed case studies. In addition, the author reviewed literature in the form of secondary data (Nkwanyana, 2015) in order to understand the concept of social sustainability and the principles of social sustainable community, also, it explained the concept of urban densification, and the dichotomy of urban densification, where the wide range of the literature drove to the determination (Kruger, 2017) of urban densification tools that were applied in the international case studies. Moreover,

density data and population number statistics for Bida Bin Ammar neighborhood in Asharej district were gathered from Al Ain City Municipality to understand clearly the social and demographic changes in residential densities over the past in Bida Bin Ammar neighborhood, where there was the old stand-alone single-family house, which is now replaced by one hundred percent built-up area on the same plot (Kruger, 2017). Then, to strengthen the dependability of this study, the collected data is linked with spatial changes observed from Google Earth maps, and photos to examine the general trends and effects of densification (Nkwanyana, 2015), and establish a strong theoretical ground (Kruger, 2017). Furthermore, CAD drawings and satellite maps are used as secondary sources of data to analyze the spatial features and building types in Bida Bin Ammar neighborhood in Asharej district. Besides, Google Earth maps are utilized to collect data about the spatial location, buildings and their attributes and shape of geographic features. In addition, documents are a secondary source of data that might be public or private (More, 2017). Another secondary source analyzed is the Plan of Al Ain 2030, which is a government document that has a detailed public policies about city planning and the strategies of sustainable developments by 2030 (Ladden, 2007).

2.5 Data Analysis

According to More (2017), data analysis is a method that helps in arranging the collected data in a significant framework. Besides, evaluation of data can be done by case studies that provide an in-depth analysis of a case or procedure. Researchers use different methods to collect detailed data over a certain period to obtain a clear analysis and understanding of a certain case study (More, 2017; Ladden, 2007). As mentioned by Ladden (2007), interpretation and analysis of the findings can be done by understanding and managing the data. In Chapter 5, the author divides the site of Bida

Bin Ammar into five Zones (A, B, C, D, and E). Each zone is analyzed according to the conceptual framework of the urban densification tools. Also, the author provided the findings for each of the study zones individually. Regarding data interpretation, the author generated maps of the area for the years of 2010 and 2019, as well as figures with detailed information regarding the properties that have undergone densification since 2010. Likert scale is used in this study to show the findings from the qualitative data retrieved from site observations of the study area. Likert scale items are usually used to show the strength of opinion on a categorical scale. Such scales are usually assigned with five categories, classified to 5 such as, insignificant to fully significant (Dittrich, Francis, Hatzinger, & Katzenbeisser, 2007). In Chapter 5, the Likert scale is used to analyze the data collected from field observations and from the maps analysis. The qualitative assessment linked to the Likert scale to make it easy for the assessment of the applied urban densification tools in the study area, where number 1 indicates to 'not applied' classification, number 2 refers to 'weakly applied' classification, number 3 refers to 'partially applied' classification, number 4 refers to ‘significantly applied’ classification, and number 5 refers to ‘fully applied’ classification. Besides, the achievability of social sustainability principles in the Bida Bin Ammar neighborhood in Asharej District is assessed by the Likert scale in Chapter 6. These principles are analyzed according to the conceptual framework of social sustainability principles and indicators. The coding system for the assessment of the principles and indicators of social sustainability is ranging between ‘fully achieved’ to ‘not achieved’, where number 1 indicates ‘not achieved' classification, number 2 refers to 'weakly achieved' classification, number 3 refers to 'partially achieved' classification, number 4 refers to ‘significantly achieved’ classification, and number 5 refers to ‘fully achieved’

classification. Furthermore, a summary of all the data then conclude the section giving a thorough analysis of responses (Ladden, 2007).

2.6 Research Methodological Limitations

Likert scale was a helpful method in the analysis of the study because it reflected the findings of the qualitative tools such as maps analysis, and field observations. However, there are limitations to applying quantitative metrics to qualitative trends, but the use of numbers of the Likert scale was just for the ease of explanation rather than trying to quantify qualitative data. Also, the author relied on descriptive explanation in the analysis of the applied urban densification tools and in the assessment of the principles and indicators of the social sustainably. Besides, the author did not rely only on numbers of the Likert scale to justify the results. Thus, qualitative assessment is linked to the Likert scale to make it easy for the assessment where number 1 indicates to 'not applied' classification, number 2 refers to 'weakly applied' classification, number 3 refers to 'partially applied' classification, number 4 refers to ‘significantly applied’ classification, and number 5 refers to ‘fully applied’ classification etc. Furthermore, social sustainability is hard to define, the author studied as much as possible from the social sustainability aspects. Some elements might be missing in the social sustainability aspects. Several obstacles happened while doing the research, such as the inability to do interviews with the decision-makers and planners in Al Ain City Municipality (AACM). It was difficult to schedule appointments with them because some of them were busy and not available due to various reasons. Besides, interviewing the specialists in Al Ain City Municipality (AACM) was not possible because of the Coronavirus emerging disease (COVID-19), and the lockdown procedures related to it. Another limitation was the inability to do interviews with the residents in Bida Bin Ammar neighborhood, due to cultural

limitations, and the impossibility to ask people in the neighborhood because most of the residents are not native, and changing regularly (the majority of the residents are from the expats, and usually they are staying for a couple of years then leaving). Lastly, a kind of bias and inaccuracy of the results may occur due to the limited time of the research.

2.7 Conclusion

This chapter laid out the research methods that were employed for this study. Qualitative research methods formed the basis for the research methodology. The researcher in this study intended to mainly investigate the impacts of the application of urban densification tools on the social sustainability principles in the selected case study (Bida Bin Ammar neighborhood in Asharej district). On a broader scale, the researcher also wanted to discuss the urban densification tools that were applied in the Bida Bin Ammar neighborhood.

Chapter 3: Urban Densification as a Sustainable Solution of Urban Sprawl

3.1 Concept of Urban Densification

Urban densification is a sophisticated subject discussion in recent debates (Mfusi, 2016). As explained by Ideas on densification of cities and other communities (2017), densification is associated with sustainability. It encourages access to different activities and not just enhancing ecological sustainability but also social sustainability. Densification can connect various parts of the city, increase security, and reduce segregation (Ideas on densification of cities and other communities, 2017). Also, urban densification can increase the number of populations to create a base for a better and vital services and more attractive living places. Additionally, according to Permana, Er, Aziz, and Ho (2015), urban densification, is similar to a compact city because both of them enhance limited land resources. When there is a presence of city sprawling, developing more compact city forms to minimize the spatial extent of urban areas is a solution to reduce the effect of the increased demand on lands.

3.2 The Dichotomy of Urban Densification

As per Kruger (2017), public authorities in different areas worldwide are targeting to increasing urban population densities because compact urban development encourages efficient use of infrastructure and minimizes the carbon consequence of automobile travel (Kruger, 2017). It is also argued that higher urban densities can support economies that are more productive and promote lively community patterns due to the proximity of residents to services and businesses, thus enhancing social cohesion. Urban densification encourages different modes of transportation, such as walking, cycling, and public transportation. It reduces the need for using private cars

and the consumption of fuel. Thus, the urban place becomes a better place to live, the air becomes cleaner, and people become generally healthier (Hoffman, Stoppenhagen, & Hahn, 2016). Moreover, Hoffman and his collages explained that urban densification enhances social cohesion. In contrast, as claimed by Mfusi (2016), densification has negative effects related to overcrowding and noise because of the high density that can be resulted from mixed-use blocks. Mufsi also mentioned that people don't prefer the high-rise buildings nor the form of social interface that allow high density of residents to come to accommodate their communities because this can affect the neighborhood character and increase the load on the use of public services. Besides, Mufsi indicated that the overload of usage of open spaces and services due to crowding, cause a degrading in the environment because it will decrease the quality of the spaces, ending by leaving these spaces unlivable without any use, and thus inevitably end up avoiding using the spaces. However, researchers proposed several components associated with crowding in communities such as density, activity, people, type of people, and their behavior and culture (Mfusi, 2016). On the other hand, as clarified by Kruger (2017), density provides access to employment, public services, and housing options. Thus, density is a strategic target to achieve social sustainability but not necessarily requiring crowded roads or high-rise structures. Therefore, exploring the positive and negative impacts of urban densification on social sustainability is an essential focus in this study to cover the gaps of densification strategy, and to propose a solution for the problems associated with this phenomenon.

3.3 Tools of Urban Densification

3.3.1 Mixed-Use Development

According to Moos, Vinodrai, Revington, and Seasons (2018), in North American cities mixed land uses is a common method applied to limit sprawl, increase density, and city diversity. There is too much argument about how to define mixed-use, but most of the scholars identify as the proximity of houses, workplaces, and services in buildings neighborhoods and districts. For Atkins (2005), a safe, livable, and attractive neighborhood can be achieved by a mixed-use tool. As mentioned by Wardner (2014), "A mixed-use development is a pedestrian-oriented development that targets to achieve a planned integration of various services and facilities such as retail, office, residential, hotel, and recreation to maximize space usage and limit the sprawl". As Hoppenbrouwer and Louw (2005) claimed that mixed-use development has been part of Dutch planning policies since the mid-1980s aiming to limit unplanned urban sprawl. It was implemented in large cities such as Amsterdam and Rotterdam, to provide mixed housing and employment opportunities. Also, in 1984, compactness and mixed-use announced in the draft structure plan (Focus on the City) to be policy goals by the municipality. Then, the plan was updated by the local government. Moreover, mixed land use reduces the need to travel because it provides a range of requirements nearby, and enhances social and physical interactions and urban vitality and quality. The provision of an adequate mix of spatial functions increases the land valuation. In the Dutch context, where land is scarce, enhancing the design of spatial quality is important to achieve mixed land-use (Hoppenbrouwer & Louw, 2005). Furthermore, Kusumastuti and Nicholson (2017), indicated in their study that to achieve vitality of the urban environment, it is important to differentiate between

primary uses “mixable” that are associated with a large number of trips, such as residential and major employment, and secondary uses “un-mixable”, which create fewer trips, such as restaurants and other small services or facilities. Thus, a balanced mix of those functions is required. Besides, the mixture of various functions is related to diversity, which is the first dimension of mixed-use. Diversity cares about mixing various functions inside a mixed-use neighborhood and cares about the ways to mix those dissimilar activities so that they can complement each other, thus avoiding conflicts. For example, offices and hotels very strongly support each other, and offices are strongly supported by retail. The intensity of synergy becomes stronger when mixing offices with restaurants because employees in offices can utilize the food services (Kusumastuti & Nicholson, 2017). Additionally, according to Cereda (2009), social segregation is an issue related to the tendency of people from the same class to live together in the same area, without mixing with people with different people cultures. In the city of Gothenburg, the most common housing type in the city is the high-rise dwelling (6/7 story) in a high-density area. The city plan contained the notion of mixing this type with terrace houses and various types of housing to avoid high and low-quality district. Thus, achieving social and cultural mix areas. As per the statistics facts of Gothenburg, the mixed-use land nowadays is only 5.1%, and the dense urban structure 1.1%. Those statistics show that Gothenburg has still a long journey to achieve a more compact form with a mix of uses, and that proves the problem of the sprawl of the city. Further, as mentioned by Robinson (2018), mixed-use development is important because it utilizes land effectively. It allows for the presence of various services and facilities that serve everyday consumer needs. People would like to buy their needs from retail or groceries that are near to their houses without the need to use their cars. Also, mixed-use developments provide diversification due to the variety of

uses and tenants. Moreover, as per Cereda (2009), Norra Älvstranden district as shown in Figure 7, is an example of a mixed-use and mixed housing project that aims to intensify the city to enhance the use of public transports. Besides, it aims to encounter the social segregation issues, by enlarging the core of the city to allow for the combination of different interest-groups to have the center as a meeting point. Thus, the expansion of the city core allows people to integrate with the city center, and then try to mix them in the same living areas.

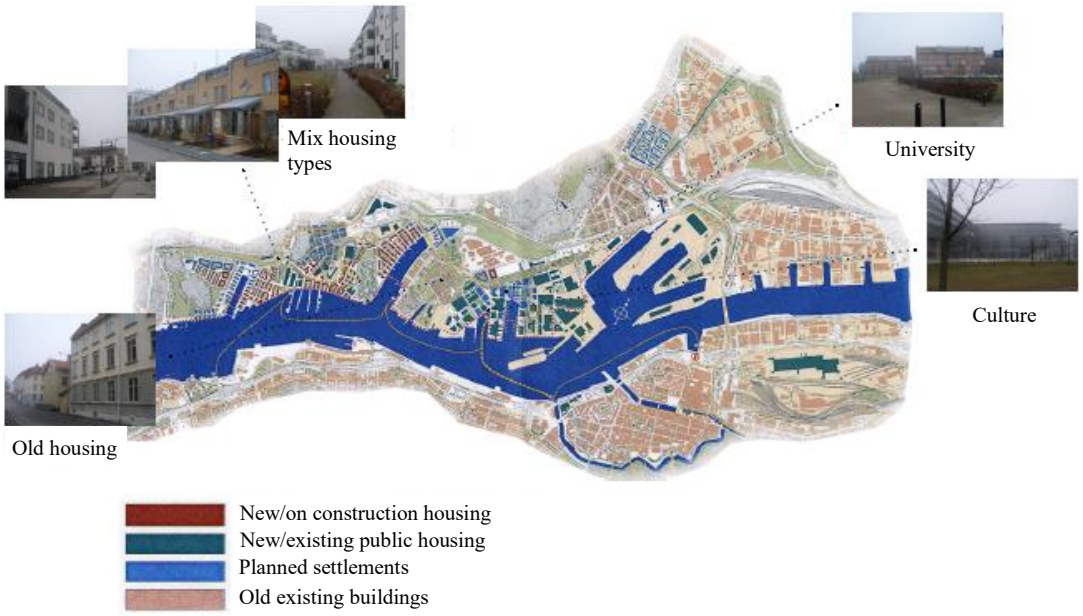


Figure 7: Norra Älvstranden District (Cereda, 2009).

Horizontal Mixed-Use

According to Esajian (2020), single-use buildings within a given complex are forming the horizontal mixed-use, that provide a variety of benefits for tenants and investors alike. Also, Esajian explained that buildings in a horizontal mixed-use development can be used for residential uses or for commercial purposes. Refer to

Figure 8. The presence of single-use buildings within a mixed-use development that provides a variety of land uses allows for the provision of integrated uses within a walkable distance in the neighborhood (What is mixed-use development?, 2020).

Vertical Mixed-Use

Vertical mixed-use means the extent of a vertical structure to contain a mix of uses (Mateo-Babiano & Darchen, 2013). The presence of different uses within the same building is called vertical mixed-use development. In vertical mixed-use, the provision of public uses such as retail shops and cafes is on the lower floor, where the provision of private uses such as office space, residential units, or hotel rooms is on the upper floors (What is mixed-use development?, 2020). See Figure 8.

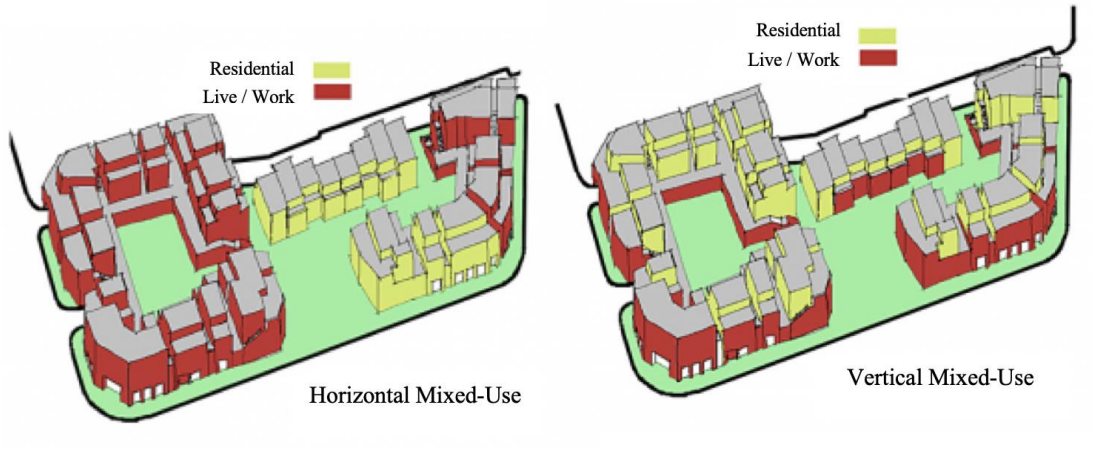


Figure 8: Horizontal Mixed-Use Vs Vertical Mixed-Use (What is mixed-use development?, 2020).

According to Kruger (2017), to increase density and to integrate the notion of living, working, and shopping, mixed-use blocks can provide this. Mixed-use blocks can be defined as multi-story blocks that contain retail, office spaces, and dwelling units for accommodation. See Figures 9 and 10 for more details. However, the most

common type of mixed-use development is a mix of residential, offices, and retail (Moos et al., 2018).

Figure 9: Mixed-Use Block (Watkins, 2011).

Figure 10: Vertical Mixed-Use Building (Stofka, 2015).

For Atkins (2005), vertical mixed-use developments are multi-story buildings usually built adjacent to buildings of similar height and scale to help them blend with existing buildings. On the other hand, vertical mixed-use is controlled by zoning codes that restrict building heights and density ratios, which can reduce the vertical capacity allowed. As per AEH (2018), the expansion of cities in size with sprawl by the car use in 19thC, allowed for the rise of building blocks above the historic urban height of 5-7 stories. In Chicago, the first modern tall building appeared in 1884 with 10 storeys. The vertical mixed urbanism can be found in Renaissance Italy, Georgian London, Haussmann's Paris, brownstone Manhattan, the tenements of Edinburgh, the shop houses of Singapore, the shawls of Bombay, the Barcelona grid block, the elevated 9-story shop houses of Hong Kong, and many others. Vertical mixed-use started first in Asian countries as Singapore, Hong Kong, and China. It is associated with the provision of various services and activities in tall buildings where uses vary from one floor to another, providing more vitality and flexibility than single-use function buildings. See Figure 11. This diversity of facilities ranging between residential, offices, and retails, allows for the utilization of the spaces twenty-four hours with their different time occupancy use (AEH, 2018). Besides, as mentioned by AEH (2018), vertical mixed-use buildings enhance the social aspect because it provides social public spaces that allow for interaction inside the building. Moreover, Huston and Mateo-Babiano (2013), explained in their study the most common considerations for the development design of vertical mixed-use, to achieve active frontage, green building rating, and diversity of residential units. First is the number of land uses it accommodates, the scale (number of floors – high rise; medium-rise or low rise vertical structures), type of land uses, and the spatial structure of land uses within the building and the age of the structure.

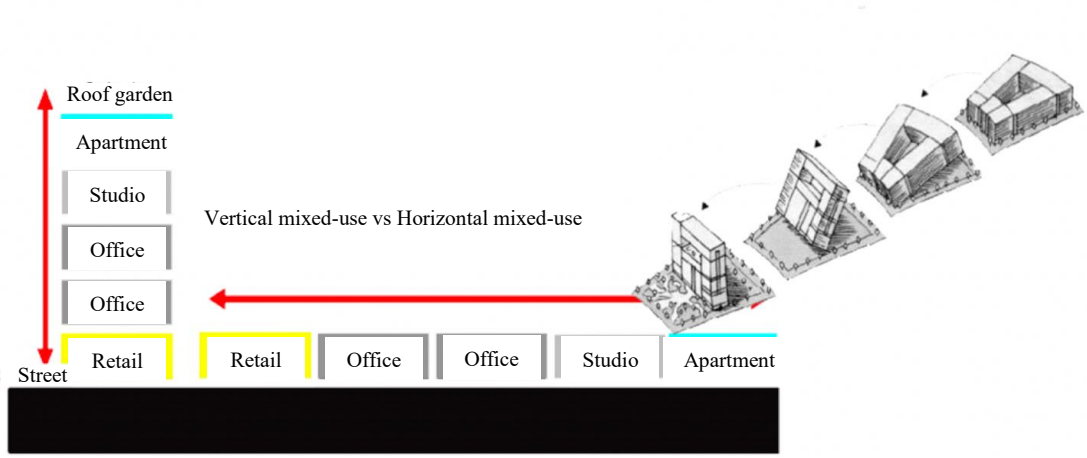


Figure 11: Bent Transformation Towards Vertical Mixed-Use (AEH, 2018).

Mixed-Use Walkable Areas

Mixed-use walkable areas combines both vertical and horizontal mix of uses in an area, within an approximately 10-minute walking distance to core activities (What is mixed-use development?, 2020). As per Kusumastuti and Nicholson (2017), the horizontal and vertical mixing is associated with the density of development and the diversity of land use. Horizontal mixing occurs when buildings are located near to each other and compromising different services and functions, such as having a cafe, restaurant, corner shop, and office building closer to each other. Additionally, the vertical dimension of mixed-use is assigned to a multi-story building with different functions on different floors. For example, the basement can be utilized for parking, the ground floor for commercial activities, the middle floors for offices, and the upper floors for apartments (Kusumastuti & Nicholson, 2017). Refer to Figure 12. Thence, mixed-use developments are a social reality generated by people, and hence can be also be changed by people. Inhabitants tend to group their activities to live, work, and shop as ‘belonging and social affiliation’ is part of human need (Wardner, 2014).

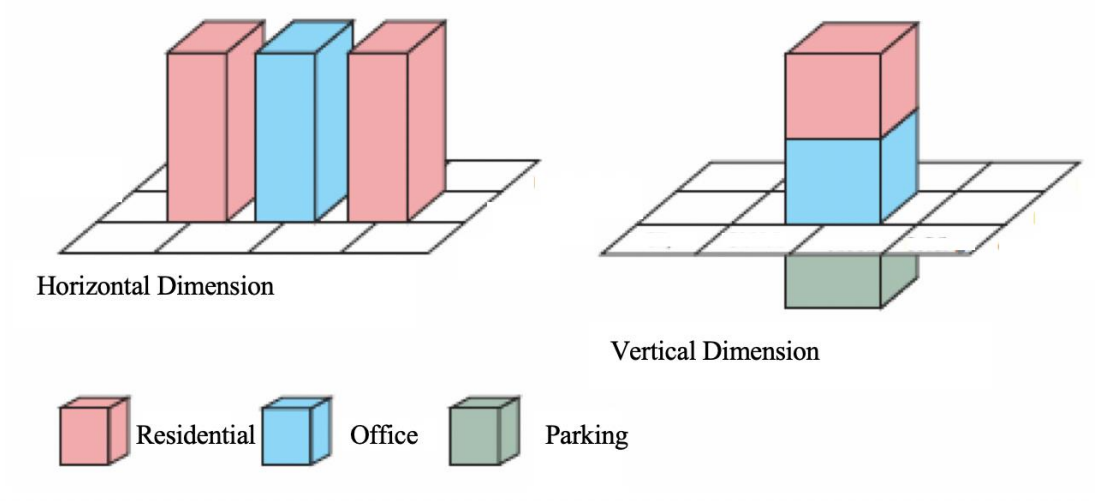


Figure 12: The Model of Mixed-Use Development (Kusumastuti & Nicholson, 2017).

3.3.2 Mixed Housing Tenure

As per Higgins and Moore (2016), mixed housing tenure occurs where owner-occupied and social housing has the same locality. The social mix can be promoted by the government policies that target to provide diversity in the social and economic profiles of inhabitants. This creates more accessibility to job opportunities, facilities (hospitals and schools), and public transport. Higher-density renewal of public housing like the Ivanhoe redevelopment adds private housing to make the project more profitable for the developers. Besides, mixed communities enhance equality, choice, and community cohesion and avoid social exclusion (Bailey & Manzi, 2008). As explained in by Mixed tenure – mixed income communities, what do we mean? (2016), tenure means how a home is occupied or held, usually by owning or renting. When families want to rent, properties may be owned privately, or by the government, or by the community housing landlords. Mixed tenure refers to any community that has these forms of rental or ownership. Private housing is owner-occupied and held as rental

investments, where, social housing contains social and affordable rentals that are provided by the government or community housing landlords. Further, to avoid the stigmatization associated with mono-tenure areas, and to make the neighborhood more attractive for people to live, it is required to integrate private ownership and rental in areas where a high concentration of low-income households have existed. Also, it is suggested to create new or replacement affordable and social housing as part of the redevelopment project. This mix of tenure can lead to the 'tenure blind' that shows the integration between properties designed for private sale and those built for social rental purposes without affecting property prices. Thus, the notion of 'tenure blind' in housing enhances the equity and similarities between residents (Mixed tenure – mixed income communities, what do we mean?, 2016). On the other hand, (Hoppenbrouwer & Louw, 2005), mentioned that mixing uses comprises three conceptual levels. The first level is increasing the intensity of land use by promoting a mix of housing tenures, which is common in North America more than in Europe. The second level is related to increasing the diversity of uses through a compatible mix. Such as mixing between residential uses and commercial or offices. The third level is concerned with environmental impacts, noise, or traffic. It includes integrating uses and is about overcoming regulatory barriers. For Higgins and Moore (2016), it is not an easy task to create mixed communities offering social and economic diversity. Sustainable housing policies should be implemented to achieve social harmony. Designing private and social housing in the same location is a difficult challenge that Australian and overseas policymakers are facing. Figure 13 shows an integrated housing development model to allow for the provision of private and affordable housing in a well-connected location (Higgins & Moore, 2016).

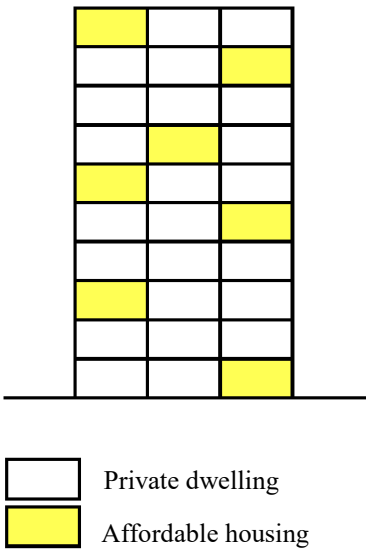


Figure 13: The Integrated Mixed-Tenure Housing Development Model (Higgins & Moore, 2016).

In addition, as per Nouwelant and Randolph (2016), there are different scales of integration that could be implemented to achieve mixed-tenure neighborhoods, such as unit by unit integration, floor by floor integration, or building by building integration, or block-by-block clusters of tenures. Refer to Figure 14 for more details.

	**Unit by unit** Each tenure is distributed uniformly across an entire development. Also called 'salt and pepper' or 'pepper potting'.	Development of Inkerman Oasis, St Kilda 
	**Floor by floor** Each tenure is clustered in distinct parts of a building. A relevant distinction in the context of large apartment developments.	Development of One Riverside Park, NYC 
	**Building by building** Each tenure is provided in separate buildings, but distributed across a development. Potential to integrate design and construction.	Development of Kensington, Melbourne 
	**Block by block** Each tenure is separated as much as possible within a development site. Still more integrated than fully segregated suburbs.	Development of Washington Park, Riverwood 

Figure 14: Different Scales of Integration in a Mixed-Tenure Neighborhood (Nouwelant & Randolph, 2016).

3.3.3 Mixed Housing Types

According to Perrin and Grant (2014), detached houses in sprawling car-oriented landscapes are widespread in North American suburbs, which led to segregating land uses. As per the new urbanism debate, contemporary community design theory suggests that mixing uses promotes urban sustainability and resilience. Besides, mixing housing types increases housing opportunities and social interaction

and integration in the community. It also encourages economic benefits, such as affordability. Local governments support the application of different housing types, such as detached and multiple units. Also, planning policy in Canada encourages mixing housing types (Perrin & Grant, 2014). Moreover, as per Housing types and sizes (2020), recently, there is a trend to have smaller dwellings and flats. This is to increase the number of units on a site and to meet the recent market conditions such as developer profit, and high land values. In 2014/15, about 80% of new homes were 1 or 2 bedroom properties in Oxford, where many developments were conversions towards smaller-sized residential units. However, as clarified in the research study of Kruger (2017), there are various housing and dwelling types. First is the single-family detached dwelling that are long-standing units each on its individual property. The size of the property usually varies between 300 and 2000 square meters and can meet the different socio-economic classes. Single-detached dwellings have more walls that are exteriorly comparing to apartments. Thus, this leads to more consumption of energy per capita dwelling than apartments (Kruger, 2017). On the other hand, although single-detached dwellings are more common in the suburbs than in most cities, Americans preferred single-family houses over other types of housing because detached housing provides more floor spaces, more distance between neighbors, and a greater sense of privacy (Bramble, 2017). Secondly, the semi-detached dwelling that is a housing type in which one or more walls of two adjacent dwellings are shared, but each dwelling has its entrance. Also, Kruger indicated in his research that row housing is a form of semi-detached dwellings where double-story dwellings can share walls and have their entrances. Besides, as clarified by Kruger, terraced housing is another type of semi-semi-detached dwelling. It differs from row housing in that row housing has a yard in the front and back of the dwelling, where the yard of terraced housing

claims the space adjacent to the unit and the roof of the lower unit. Thirdly, as per Kruger (2017), courtyard dwellings are another type of housing that takes the L- or U-shaped to create communal courtyard areas within the development, which helps in enhancing the sense of community. Finally, Kruger indicated that mixed-use blocks are multi-story developments in which retail and office spaces are present with a number of dwelling units. Mixed-use blocks enhance the density and encourage the notion of living, working, and shopping within the same development.

3.3.4 Intensification

Intensification occurs in an already urbanized area and refers to high-density development. It is related to the construction of previously developed land, and can occur on undeveloped or previously developed land (Intensification: What it is and what it promises, 2013). As clarified by Cubitt, intensification means urban renewal, urban consolidation, reuse of existing structures, neighborhood preservation, and infill housing. Intensification is a sustainable plan for city growth that enhances the existing urban fabric of the communities and their surroundings. Moreover, intensification is a Canadian term, first introduced with affordable housing debates in the 1980s, to provide strategies to increase the residential utility of a certain community. Intensification strategies include infill redevelopment, adaptive re-use, and suburban densification (Cubitt, 2008). Intensification contributes to accommodating higher population densities and utilizes less greenfield land for new housing. Thus, when density increases, automobile use declines in favor of transit, walking, and cycling. Also, intensification promotes more efficient use of public urban infrastructures such as "soft" infrastructure such as public schools and social services. As a result, development in already urbanized areas plays to the city's strengths rather than

spreading its resources over an ever-wider territory (Intensification: What it is and what it promises, 2013).

Bulk Rights

As clarified by Kruger (2017), increased bulk rights can enhance the density on a specific property. Bulk and massing can control the amount of construction in a specific area through particular zoning regulations that affect the volume and spacing of buildings on the land. Moreover, as per Glossary of planning terms (2020), floor area ratio (FAR) is a primary bulk regulation that controls the size of buildings. Besides, it is an efficient tool to calculate the bulk or mass of building volume on a development site. FAR can be implemented with other development standards such as building heights, lot coverage, and lot area to promote the form of development. Higher FARs mean greater building volume. Also, the mass and scale of development can be controlled by FAR that can limit the intensity of land use to minimize the environmental impacts of development. Further, FAR is calculated by dividing the gross floor area of a building(s) by the total buildable area of land upon which it is built (Calculating floor area ratio, 2015). See Figure 15.

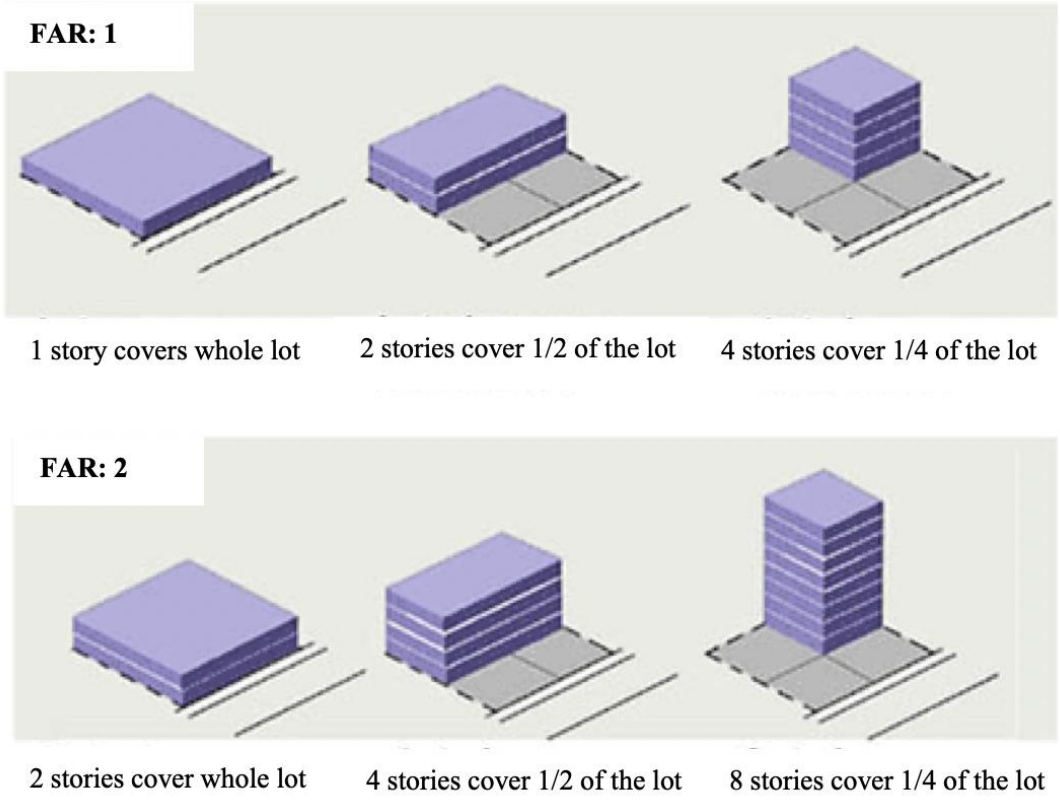


Figure 15: Floor Area Ratio Implementation (Calculating floor area ratio, 2015).

On the other hand, according to Glossary of planning terms (2020), the maximum amount of floor area allowable on a zoning lot in a district can be found by multiplying FAR by the lot area of the zoning lot. For example, on a 10,000 square foot zoning lot in a district with a maximum FAR of 1.0, the floor area on the zoning lot cannot exceed 10,000 square feet. Refer to Figure 16. Additionally, according to a setback is the portion of a building that is above the base height (street wall or perimeter wall) before the total height of the building is achieved. The position of a building setback in contextual districts is specified by distances from street walls. Besides, the yard is an open area along the lot lines of a zoning lot that should be unobstructed from the lowest level to the sky, except for specifically permitted obstructions. Therefore, bulk regulations are an integration of controls (lot size, FAR,

lot coverage, yards, setback, open space, and height) that assign the maximum size and placement of a building on a zoning lot (Glossary of planning terms, 2020).

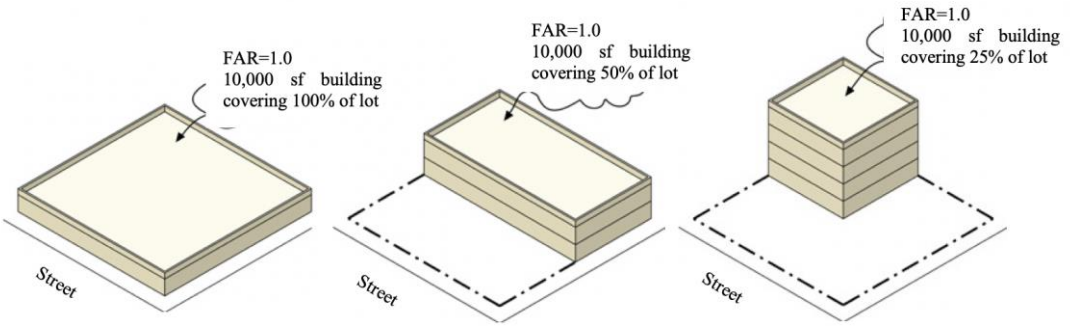


Figure 16: Floor Area Ratio (Glossary of planning terms, 2020).

Subdivision of Property

Subdivision refers to dividing a parcel of land or a building into one or more further parcels, or a rearrangement of property boundaries, or changing an existing boundary location. Subdivision does not alter the land use by itself. Land use is altered by the ones who subdivide the land (Introduction to Subdivision, 2017; Planning resource guide. Subdivision in Manitoba, 2016). In addition, as mentioned by Nixon (2013), subdivision increases the chances of investment and allows existing homeowners to participate and redevelop their land or dwellings. Moreover, as per Kruger (2017), existing properties can be subdivided to provide additional housing. This method is associated with re-zoning because it requires lowered standards for property sizes through zoning. Furthermore, Introduction to subdivision (2017) clarified that the subdivision can address the environmental impacts of intensification and change in land use. Land subdivision creates separate certificates of title, which can determine an existing interest in land (including buildings) and impose limitations

on landowners or for how the land can be used or developed (Introduction to subdivision, 2017). According to Planning resource guide. Subdivision in Manitoba (2016), there are different types of the subdivision. Firstly, is the standard subdivisions, which are the most common type. It generates two or more additional lots. See Figure 17 (a). Secondly is the minor subdivision, which is related to the single-lot subdivisions process. Refer to Figure 17 (b). Thirdly is the bare land condominium plans that are like a plan of subdivision that show parcels of land as units. These units can contain buildings, but the building will not completely cover the unit. See Figure 17 (c). Subdivision provides the chance for laypeople to participate in the redevelopment and allows homeowners to redevelop their land or dwellings to generate wealth and investment (Nixon, 2013).

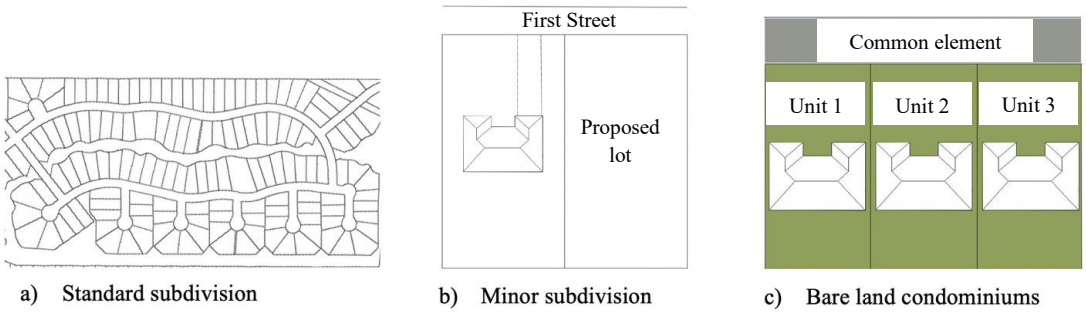


Figure 17: Types of Subdivision a, b, c (Planning resource guide. Subdivision in Manitoba, 2016).

Additionally, a terraced “blocks” or rows of semi-detached housing are occurring in the European suburban, where single, free-standing dwellings are the pattern that occurs in Australia. Also, the increase in housing density and a range of sub-optimum outcomes results from these subdivisions (Gudes, Glackin, & Pettit, 2018). Moreover, as per Moudon, many single houses were subdivided into two or more apartments to accommodate more units and to serve low-income people by

renting parts of them. In American cities, there are tight land-use regulations regarding the subdivision, but these laws did not stop the people from subdividing their single-family houses to insert secondary units in their homes. See Figure 18. However, the size of the secondary units must be smaller than the principal unit, where one or more off-street parking spaces should be provided for the additional unit. Also, the minimum size for the subdivision of houses should not be less than 2,000 square feet (Moudon, 2015).

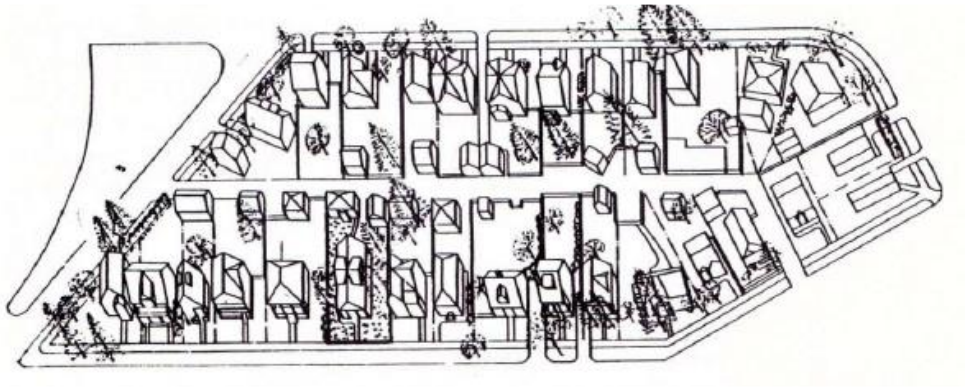


Figure 18: The Second Units Insertion in Block with Alley Access (Moudon, 2015).

Attached/Detached Second Dwelling

According to Kruger (2017), when there is sufficient space on a property, it is possible to build an additional structure to increase the units. People usually change the use from non-residential into residential such as converting a garage to a dwelling unit. However, the addition can be attached to the existing structure, or it can be constructed in the backyard of the property (Kruger, 2017). For Cubitt (2008), increasing the residential density without significant visible change can be done through the application of Accessory Dwelling Unit (ADU), which can be a new building addition to an existing house, or an existing building conversion (such as a garage) that creates additional residential density in a community without significant

visible change. ADUs can be offered for renting or built for an elderly parent or adult child (Cubitt, 2008). In addition, as clarified by Brian (2020), accessory dwelling units have three types. Firstly, the detached structures which are tiny houses that provide more space and are located in the main home's back or side yard. Since the unit is entirely detached, it has a building and maintenance costs and needs mechanical appliances (water heater, etc.), and likely requires more raw material to construct. Secondly, the attached external apartments that share at least one wall with the main house, and have separate entrances, and share no internal connections with the main unit. They may share mechanical appliances with the main unit, depending on the existing appliances' capacity. Thirdly, the attached internal apartments are fully integrated into the existing structure of the main house in a finished basement or attic, and could not be immediately noticed from outside that the property contains two separate housing units. They mostly share utility service and mechanical appliances with the main unit. Thus, they're the cheapest of the three attached and detached dwellings options (Brian, 2020). Refer to Figure 19 for more clarification for the types of accessory dwelling units.

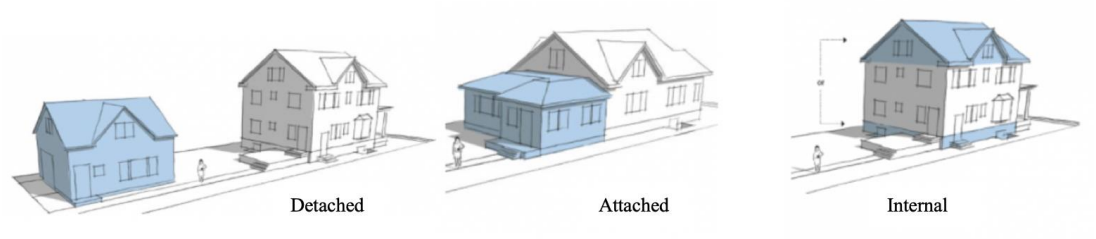


Figure 19: Types of Accessory Dwelling Units (Accessory dwelling units , 2020).

Furthermore, as mentioned by Accessory dwelling units (2020), internal, attached, and detached dwellings increase housing affordability, provide more housing options within the community, and enable seniors to stay near family as they age.

Accordingly, many cities support the presence of attached and detached dwellings in their zoning plans and regulations in low-density residential areas. Besides, as clarified by Accessory dwelling units (2020), the State of Oregon recognizes attached and detached dwellings development as an opportunity to improve housing supply and affordability. In 2017, the State legislature passed Oregon Senate Bill 1051, requiring certain cities and countries to allow attached and detached dwellings in all areas within the Urban Growth Boundary zoned for detached single-family dwellings.

Consolidation

As defined by Kruger (2017), consolidation of property is where two or more properties are consolidated under the same property number. Consolidation is a tool of densification that enhances the density. It can either be used to increase densities by linking two houses and developing them to increase the number of units, or properties are consolidated and their structures demolished to be redeveloped with large apartment blocks (Kruger, 2017). Moreover, as argued by Planning resource guide. Subdivision in Manitoba (2016), joining together more than one lot creates a new single lot. Consolidations do not require planning approval. Also, consolidations can be part of a subdivision proposal (Planning resource guide. Subdivision in Manitoba, 2016). According to Bartoszczuk and Delnicki (2018), in the city of Józefów (the "Kolonia Błota" area), corrections of the existing divisions were undertaken in 3 out of the 18 analyzed plans. Areas of "common activities in the scope of consolidation and secondary division of property" were designated to implement land consolidation, either by the statutory provisions or as an individual arrangement of property owners. In two of the cases, there is a lack of transport services of part of them, and one of these areas covers three elongated plots with a width of approximately a dozen meters,

making their individual building development impossible. However, by implementing the consolidation process and secondary division, the created plots will be oriented with their longer sides towards the roads, which will largely reduce their privacy. See Figure 20.

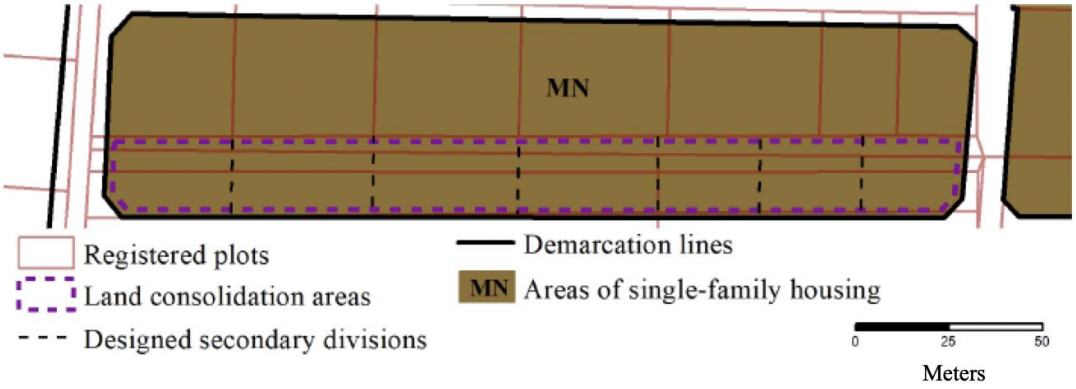


Figure 20: An Area Designated for Consolidation and Secondary Division Into Building Plots (Bartoszczuk & Delnicki, 2018).

Horizontal Extension

As defined by Attia (2015), the horizontal extension is a development that adds an extra area to a certain building. Refer to Figure 21. It is also referring to building extra rooms or extending current balconies. A horizontal extension through rear extension in single-family houses is applied in the case of 9 studied neighborhoods of Liège. However, the horizontal extension is not effective to densify the built environment in Liège because most of the buildings have double façades. The front extension is not possible due to the roads and sidewalks spatial limits and the rear extension is the not possible in most investigated building in the 9 neighborhoods due to the limited back space. On the other hand, it is difficult to increase urban density significantly by the front and side extension (Attia, 2015). Hence, horizontal extension utilizes the land around the dwelling unit, but if the available land is limited or the

council setbacks are too restrictive, then a vertical first-floor addition is more appropriate because it will increase the square meters of the floor area without taking up the surrounding land (Kolarik, 2020).

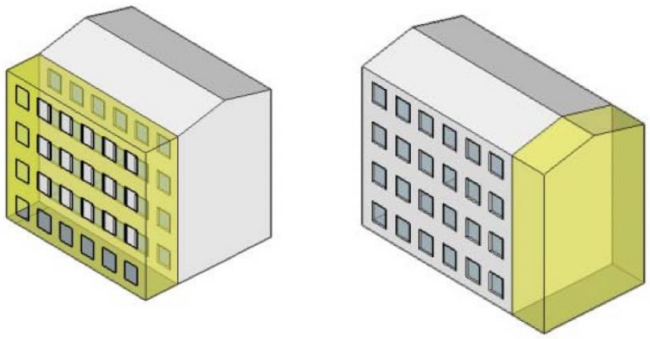


Figure 21: Horizontal Extension (Attia, 2015).

Vertical Extension

For Attia (2015), roof-raising is a tool to increase the density where the external growth is either limited or inappropriate. Besides, it counters the urban sprawl and enhances the energy retrofitting of the existing building stock. Roof rising is implemented in Liège and other Belgian cities. Moreovrer, as clarified by Attia (2015), there are special policies in cities that control the application of roof-raising. In Liège, the vertical extension is implemented by combining prefabricated facades with the building envelope. See Figure 22. These prefabricated facades are stacked up a new story or penthouse units for mid-rise (2-4) buildings. Several challenges face the vertical extension method such as the combined renovation urban regulation for each neighborhood. The street aspect ratio and maximum height in relation to solar access define the maximum height and consequently stacking ability. The car parking facility and the ability to provide parking space for every new household can also be another

challenge. Besides, the façade typology is a concern especially if the façade has a clear identity or is considered as an architectural heritage the prefabricated facades system will not be accepted (Attia, 2015).

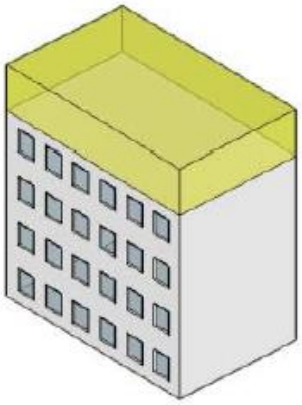


Figure 22: Vertical Extension (Attia, 2015).

Furthermore, the neighborhood around Canal Saint-Martin is an example where the vertical extension was applied. According to Kouthoofd and Szczesniak (2020), the addition of 140 extra dwellings in the neighborhood was done by extending the mansard roof buildings alongside the canal. The Mansard roof was a constraint to extending the older buildings upward. However, Miroirette which is an apartment typology, is associated with providing rooftop extensions that allow for the extension above the mansard roofs of the existing building, without having to demolish the mansard roof. See Figure 23.

Figure 23: The Neighborhood Around Canal Saint-Martin, Paris (Kouthoofd & Szczesniak, 2020).

On the other hand, as per Building upwards in Paris (2020), adding value to a building and a community can be achieved by extending urban construction upwards which visually enhances and extends a solid construction. Building upwards is lightweight and quick to construct. Moreover, as mentioned by Ogorodnikov and Ogorodnikov (2017), vertical extension was applied to a three-story townhouse building in Greenwich Village through the addition of an extra floor. Refer to Figure 24. Additionally, as argued by Artés, Wadel, and Martí (2017), the vertical extension is an original approach for enhancing the existing buildings, and efficient method that provides a new model of operation and management to the market.

Figure 24: 78 West 3rd Street in Greenwish Village (Ogorodnikov & Ogorodnikov, 2017).

3.3.5 Infill Development

Infill development helps to counter the problems associated with low-density and urban sprawl by utilizing the use of existing services in communities (Infill development, 2013). The article further explained that urbanization causes many communities to have vacant lands within their vicinity, and infill development is a tool to fill in the gaps in the leftover lands in a community. Also, it enhances density and promotes the adaptive reuse of existing structures (Infill and redevelopment, 2014). According to (Alfirević & Simonović-Alfirević, 2015), infill is the urban planning term for the reuse of land in an urban environment (open-space, to new construction).

As defined by (Kamal, 2014), infill refers to the development of vacant parcels within previously built-up areas of existing communities that have in-place infrastructure such as transportation and other services and utilities. In urban planning, infill development is associated with sustainability, smart growth, and brownfields, which allows building on a small land between existing buildings (Mirmoghtadaee, 2010). See Figure 25.

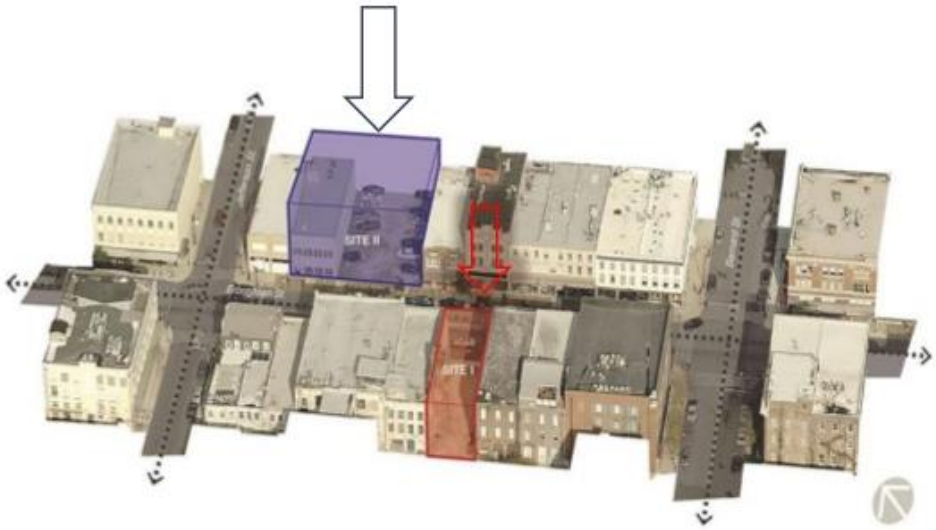


Figure 25: Infill Vacant Land (Jalal, 2015).

As explained by Infill development (2020), a successful infill development strategy should be implemented efficiently in neighborhoods, and the design of infill development needs to be integrated and fitting with the existing context and to obtain neighborhood acceptance. Also, as per Infill development (2020), high density can enhance the use of different modes of transportation with the presence of various facilities which lead to successful infill development. Besides, infill is similar to mixed-use development because it revitalizes parts of a city and uses land more efficiently through the provision of easy access to existing utilities and transportation options (Infill development, 2013). Moreover, infill is a housing strategy that supplies

different housing types from a single house to a multi-unit development and provides new residential development that is built on unused or underutilized land (Cubitt, 2008). Additionally, infill development is a housing strategy that helps in the conservation of land, and the creation of community centers (Hampshire, 2008). Further, according to the Denver Regional Council of Governments - Regulatory strategies for encouraging infill and redevelopment (2006), infill conserves farmland, and open spaces, and reduces the need for converting more land from non-urban to urban uses. The application of infill strategy between 1990 and 2000 protected over 55 additional square miles of farmland and open space. Metro Vision believes that infill will continue to occur and as a result it will reduce the need to develop "greenfield" on the outer perimeter of the urban area (Regulatory strategies for encouraging infill and redevelopment, 2006). As clarified by Aliyu (2018), infill enhances cultural growth and allows for the utilization of existing resources. Besides, it is an environmentally friendly method that develops the social sustainability of neighborhoods. Furthermore, infill buildings provide a proper combination of uses and conserve people's financial resources by utilization of existing structures. As well, it enhances walkability through the provision of safe and pleasant pedestrian environments. Also, Aliyu (2018) mentioned that infill buildings allow for the presence of new mixed-use neighborhoods that supports the sense of belonging to the place that was left as a result of old development years ago. Therefore, infill developments are useful in enhancing a community's livability and increasing residential density. Likewise, it allows for interactions of residents in the community and develops economic and social vitality. On the other hand, infill buildings refer to the successful application of new buildings within existing contexts or old sites that developed previously. Refer to Figure 26. Thus, while designing the infill buildings,

several factors such as design proportions, materials and color, facade compositions, and street relations need to be considered to ensure the integration of new buildings with surrounding buildings (Aliyu, 2018).

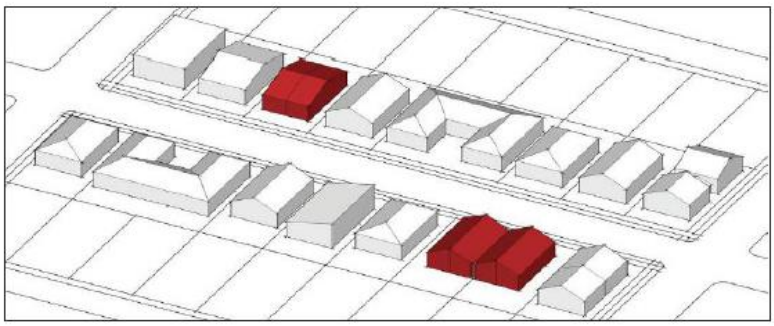


Figure 26: Integrated Infill Buildings with the Existing Structures (Aliyu, 2018).

As explained by Cubitt (2008), most of the applied infill strategies are residential, due to market demand. Integrated residential infill development within an existing community allows for further retail and commercial development. Cubitt also clarified that in the Kirkendall North neighborhood in south-west Hamilton, Ontario, infill was appropriate at the three scales of low, medium, and maximum density. It included freehold laneway houses, accessory dwelling units, commercial infill opportunities, and pocket developments. This infill increased neighborhood households by up to 68%. See Figure 27 for more details. As a result, Hamilton supplied projections up to 80,000 new households for the next 25 years through the application of a plan which complied laneway infill that enhances diversity and encourages more sustainable ways of living, and sustainable growth of enduring cities (Cubitt, 2008).

Kirkendall North Blanshard
Lane neighborhood
(5.2 hectares – excluding commercial buildings and park)
82 houses (12% duplex)
Existing density = 17.7 hph

Existing lot study

- Optimal infill potential
- Merge-lot infill potential
- Multi-unit development
- Limited/ no infill potential
- Park/ greenspace

Scenario one:
Low density infill

18 infill houses
Density = 21.1 hph

19% household
Density increase

Option two:
Medium density infill

Two rear lots can be grouped together in order to gain access

Multiple units may be built on a lot

32 infill houses
Density = 23.8 hph

34% household density increase

Option three:
Medium density infill

Encourage multi-unit development and shared access of units

63 infill houses
Density = 29.8 hph

68% household density increase

Figure 27: Infill in Kirkendall North Neighborhood in South-West Hamilton (Cubitt, 2008).

Demolition and Reconstruction

As clarified by Attia (2015), urban infill and demolition are effective tools of urban densification. In Liège City, a demolition is a tool included in any urban densification strategy. In a city where more than 86% of its building stock was built before 1965 and the renovation rate did not exceed 0.5%, in the last 30 years, a large percentage of buildings are in a seriously degraded state. Before the renovation, it might be easier and cheaper to demolish existing buildings and achieve urban densification through urban renewal. Besides, Attia mentioned that on a district level, demolition can provide new housing units and finance the renovation of other buildings. Demolition is "The complete removal of structure or a scope of construction (alteration, addition, renovation or reconstruction) of a structure where only the foundation of the original structure remains" (Decatur defines demolition, 2014). Moreover, demolition and redevelopment help in replacing substandard buildings with new ones that meet construction standards and functional requirements. Recently, extensive urban renewal projects throughout China have resulted in the large-scale demolition of existing buildings (Xu, Shen, Liu, & Martek, 2019). On the other hand, as claimed by Power (2010), demolition is often solely advocated to remove unsound or unwanted buildings. Since 2003, housing demolition has been adopted (with UK government support) as a tool for the regeneration of housing markets to accommodate the new housing conditions. Many argue that demolition is harmful to the environment, costly, and damaging to the long-term community networks that grow slowly within housing areas. Therefore, demolition should be the last alternative for application on a bulky and valuable material object (Power, 2010). Besides, Trabucco and Fava (2013) also mentioned that when there are no viable alternatives to keep a building as it is, the demolition of the building happens. Furthermore, as per Infill equals demolition

(2013), hundreds of homes are being demolished each year to be replaced with either larger houses or multifamily housing as Portland builders often demolish one home and replace it with a one that is four times the size of the house it replaced.

Chapter 4: Case Study of Bida Bin Ammar Neighborhood

4.1 Background

Al Ain city which is located in the United Arab Emirates (UAE) on the border with Oman, is a model city of urban sprawl (Martin, 2004). It is located approximately 150 kilometers east of Abu Dhabi city and 150 kilometers south of Dubai. Also, it is the fourth largest city in the UAE, and has an estimated metropolitan population of approximately 400,000 residents. See Figure 28 for more clarification. Physical and economic development in the contemporary Al Ain had indicated a critical turning point due to the rapidly expanding population. Besides, a policy of very large plot allocations have filled out most of the available land. However, to preserve the city character, tradition, and culture, a decision of how to develop Al Ain city should be taken (Plan Al Ain 2030: urban structure framework plan, 2009).

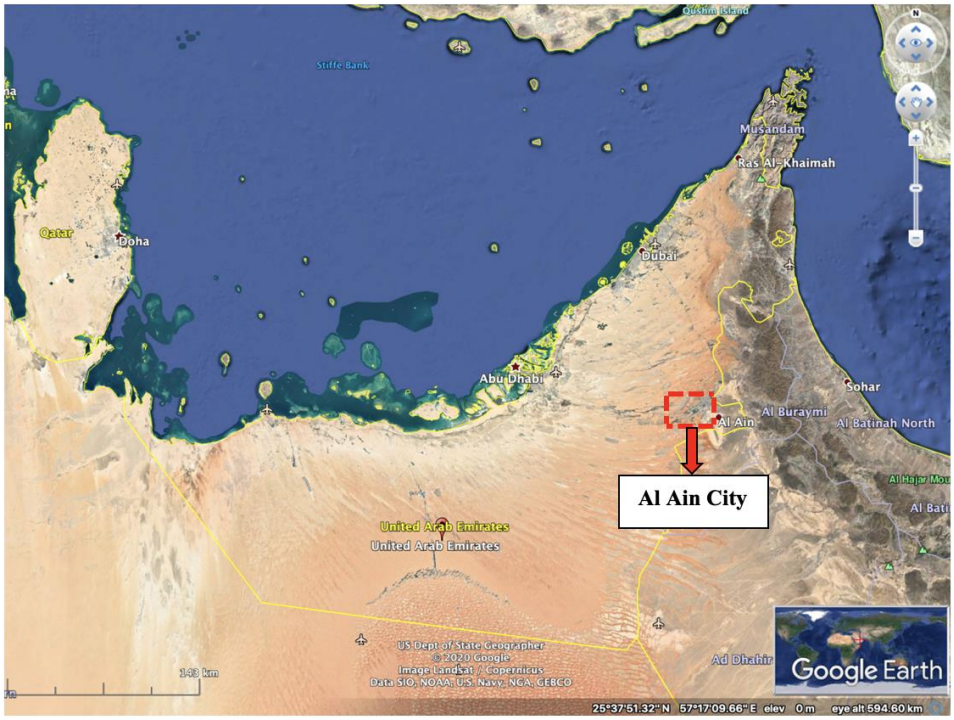


Figure 28: UAE Map (Google Earth Maps, 2020).

4.2 Plan Al Ain 2030

According to Plan Al Ain 2030 (2009), an ancient culture has shaped the new society of Al Ain. Plan Al Ain 2030 has a crucial aim to meet the need for Emirati housing in the future. History is the source of inspiration for the strategic policies in the urban structure framework of Plan Al Ain 2030. These policies are grounded by three pillars of sustainability, which are the natural environment, economic development, and cultural heritage, to meet the needs of the growing population, control the development trends, and recommend proper actions directed to urbanization and urban sprawl. A series of nodes run the length of the city in the east-west direction contain multi-family Emirati residential density. The Central Business District (CBD) and Asharej are two of these nodes of a higher order, which contain significant office density, and retail density forming a critical mass of well-mixed uses that support transit ridership (access to transport and amenities), and walkability. A higher-order center strategically at the node of Asharej is located at the intersections to the airport. Universities, hospitals, and knowledge-based industries surround Asharej node. There are similarities between Asharej and the CBD in residential density and jobs, but it is 10 km distant from the CBD. Anyhow, allocation of density and mix of uses in the university areas along Khalifa Bin Zayed road is enhancing the major node in the Asharej district. In addition, housing for the bulk of the population of Al Ain will be in Al Maqam, Asharej, and Al Muwaiji that will join the Central District by 2030. Refer to Figure 29 for more details regarding the location of Asharej district. Commercial roads that combine street-level retail with higher density housing are near to the new Emirati neighborhoods that are mostly characterized by lower densities. Gross density of the housing is proposed to be low and around 4.5-5.0 units per hectare, with plot sizes of 30 x 36 m. Al Ain Plan 2030 displays areas appropriate

for this development, which contains non-residential requirements such as schools, parks, mosques, roads, amenities, and commercial development.

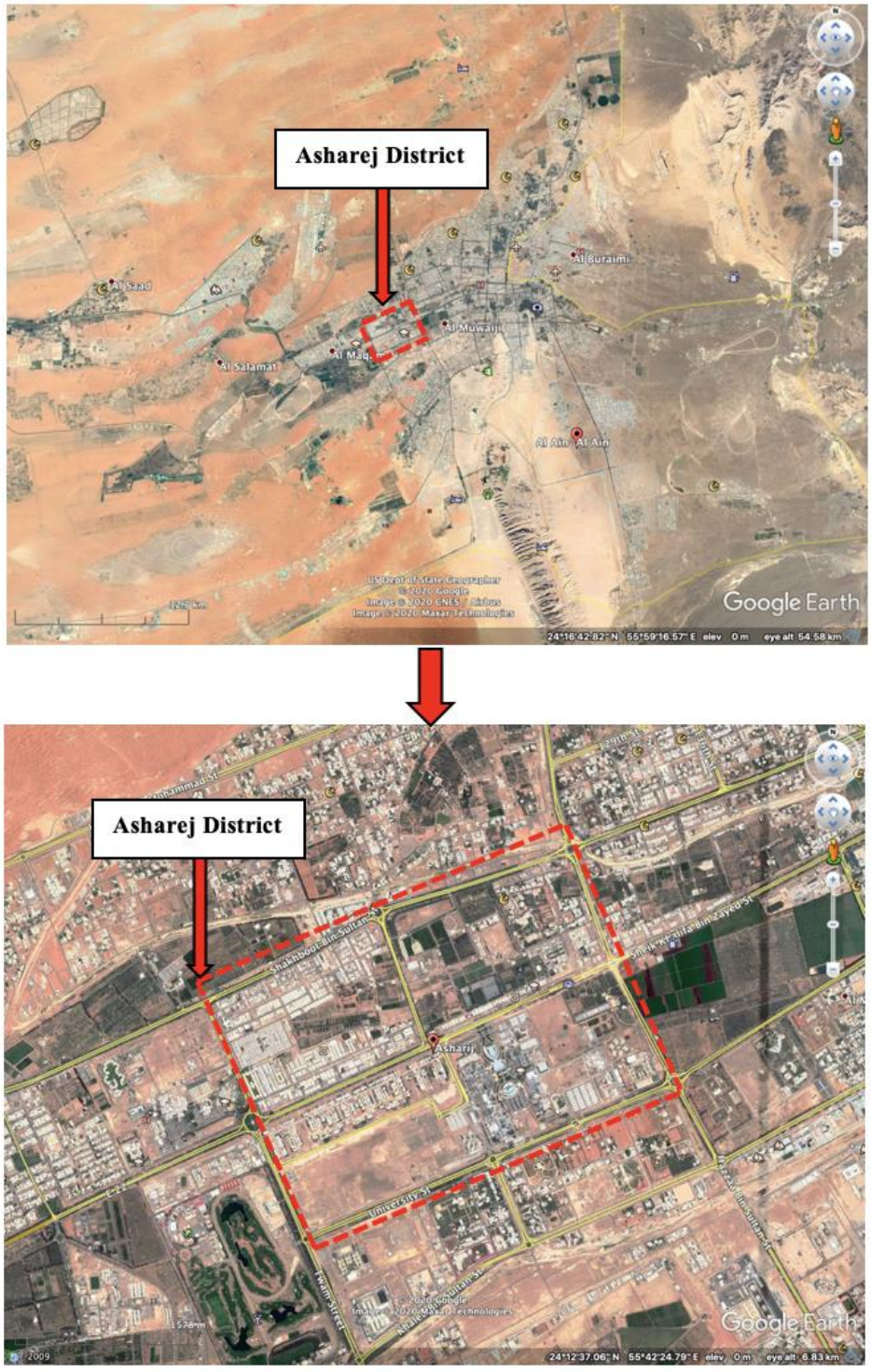


Figure 29: Location of Asharej District in Al Ain City (Google Earth Maps, 2020).

The growth of Al Ain for the coming quarter-century is shaped by conceptual solutions that are taken from the Urban Structure Framework Plan of Al Ain Plan 2030. Three phases are visualizing Plan Al Ain 2030. These phases are a recommended series of development intensity, and there is no specific timeline assigned to them. Phase 1 contains the land-use concept plan, including Asharej node and the CBD redevelopment. This Urban Structure Framework concentrates on residential density into nodes along a corridor serviced by rapid transit that will allow flexibility of development over time. See Figure 30. Since there is a rapidly expanding population, this flexible structure of the land-use plan is able to accommodate more or less density over time. Therefore, the city will utilize a distinctive urban design, architecture and various types of employment. Also, intensification of development at the nodes, and the surface tram system are provided in phase 2 which includes the main elements of the Gateway Corridor. Furthermore, the allocations of Emirati housing and the redevelopment of existing older areas are included in phase 3. However, infill and redevelopment of smaller parcels in Al Ain city shall appear during all phases.

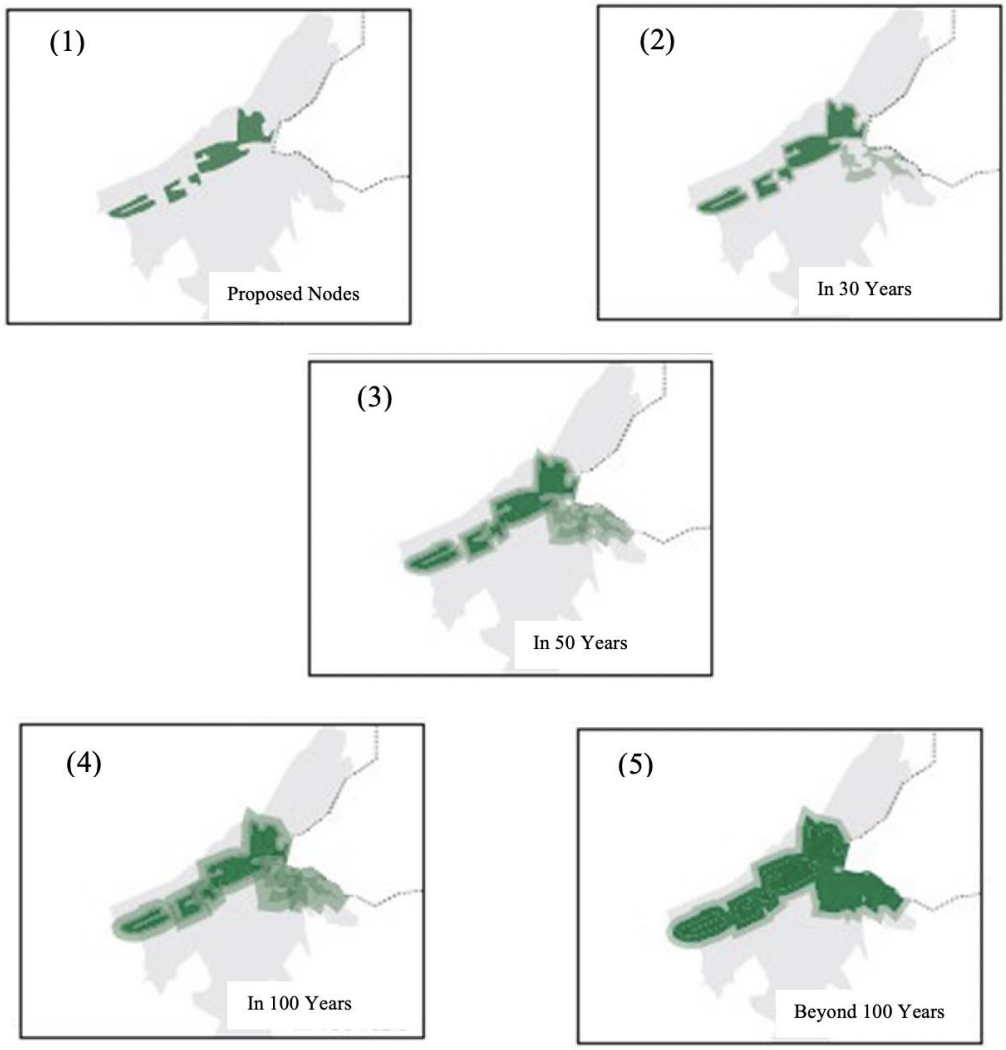


Figure 30: Expansion Over Time in Al Ain City 1, 2, 3, 4, 5 (Plan Al Ain 2030, 2009).

4.3 Suggested Urban Densification Tools in Plan Al Ain 2030

The conceptual solutions of the Urban Structure Framework in Plan Al Ain 2030 are shaping the growth of Al Ain city. These solutions determine the main issues that shape the urban form, environmental context, land use distribution, transportation infrastructure and network of connected open spaces, and then continue through more detailed analyses at finer scales. A corridor that is running the length of the city between two main wadis is including the concentration of dense mixed-use

development into nodes as per the land-use framework plan. Refer to Figure 5 in Chapter 1 for more details. These nodes contain multi-family housing with offices and retail space to enhance the critical mass of residential and employment density that will make the planned development alive. Since there is a growth in the population over the next quarter-century and a lack of available land, allocating Emirati housing is a challenge that needs to be considered. Redeveloping brownfield sites is an effective sustainable strategy that can meet the expanding demand of Al Ain in its housing market. Besides, certain areas of new greenfield sites have been determined not to harm sensitive ecosystems or landscape features. Moreover, urban infill is applied significantly, when there is existing unused old housing and current uses that are obsolete. On the other hand, Emirati housing is contained significantly in medium-density areas, outside of the high-density nodes along the corridor. It is proposed that district centers contain a critical mass of residential and retail density with proximity of low-density housing in order to maintain sustainable local communities that can be accessible for working and shopping. Besides, infill redevelopment is prioritized in low-density neighborhoods to maintain the significance of this housing option, within a proximity to the district centers and corridor nodes. Furthermore, setting G+4 or 20 m as the maximum allowable height of development is a royal decree by the late Sheikh Zayed, Father of the Nation that has highly adopted by the Plan. Anyhow, to maintain privacy and view corridors in lower-density neighborhoods, G+2 is the maximum allowed height. Besides, a building height limit of 20 m will preserve Al Ain's characteristics as a low-scale city. This built form (G+4 height) envisioned as ground floor with a maximum of four floors above (including mezzanines, penthouses, architectural appurtenances, or mechanical provisions).

4.4 Bida Bin Ammar Neighborhood

Bida Bin Ammar neighborhood is located in Asharej district in Al Ain City. It occupies an area of 211.3 hectares. Bida Bin Ammar neighborhood is adjacent to Shakhboot Bin Sultan Street from the north, and to Sheikh Khalifa Bin Zayed Street from the south. Moreover, it is bordered to the west by Tawam hospital, and to UAE University in the south. Besides, Abu Dhabi University which, is located in the Al Dafeinah neighborhood, is bordering Bida bin Ammar neighborhood from to the east side. See Figure 31 for more details. As stated by Al Ain region 2030 demographic forecasts (See Figure 1 in Appendix A), the total population in 2010 for both Emirati and foreign people in Bida Bin Ammar neighborhood was 2973, where the expected total population in 2030 will be 4797.

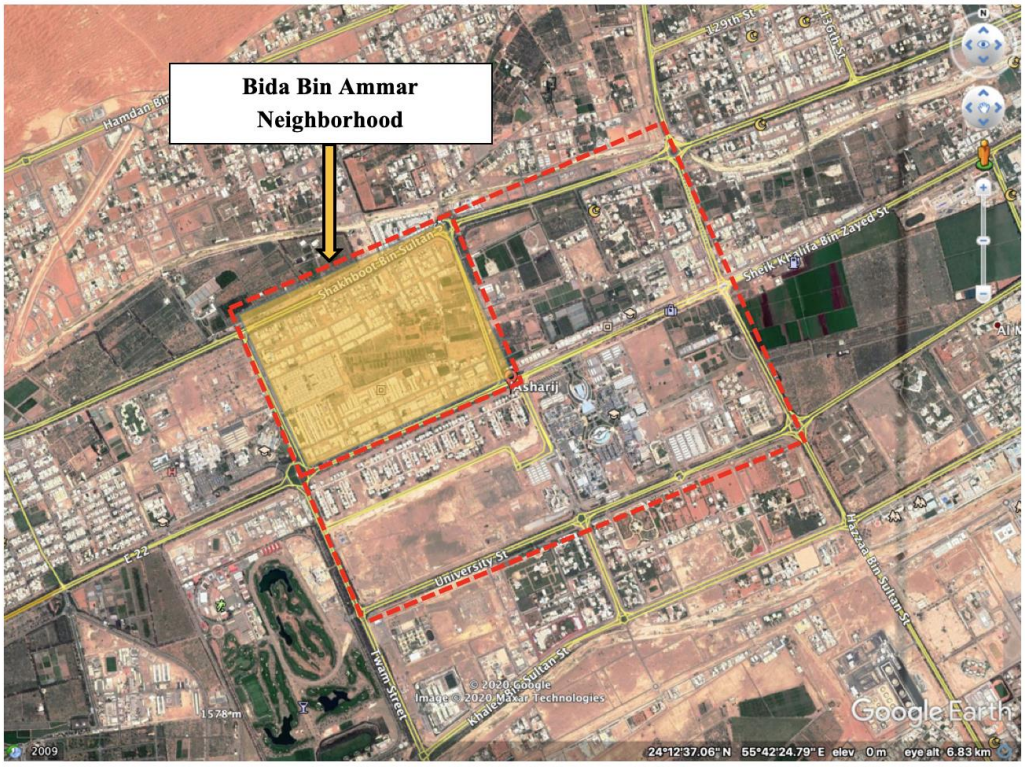


Figure 31: Bida Bin Ammar Neighborhood in Asharej District (Google Earth Maps, 2020).

4.4.1 The Gradual Transformation of Bida Bin Ammar Neighborhood from a Sprawl to a Densified Urban Area

The author divided the site of Bida Bin Ammar neighborhood into five zones (A, B, C, D, and E). Refer to Figure 32 for more clarification. Zone A is located in the south of Bida Bin Ammar neighborhood, and it is adjacent to Sheikh Khalifa Bin Zayed Street. In addition, Zones B, C, and D are located inside the Bida Bin Ammar neighborhood. Moreover, Zone E is located in the north of Bida Bin Ammar neighborhood, and it is adjacent to Shakhboot Bin Sultan Street. Furthermore, Figure 5, sheds light on the transformation that happened in the Bida Bin Ammar neighborhood in Asharej district from 2002, 2010, to 2019. Also, it highlights the changes that happened in each zone out of the five zones. Different methods of densification were applied in each of the study zones, such as the infill strategy that has been applied dominantly in Bida Bin Ammar neighborhood. However, each zone is analyzed in Chapter 5 according to the conceptual framework of the urban densification tools. See Table 2 in Appendix A.

4.5 Conclusion

This chapter clarified the location of the study area, which is Bida Bin Ammar neighborhood in Asharej district in Al Ain city in UAE. Also, the chapter discussed the three phases of Al Ain Plan 2030, and the applied tools of urban densification according to it. In the end, this chapter displayed the gradual transformation of the Bida Bin Ammar neighborhood in Asharej district from sprawl to the densified urban area during the years of 2002, 2010, and 2019.

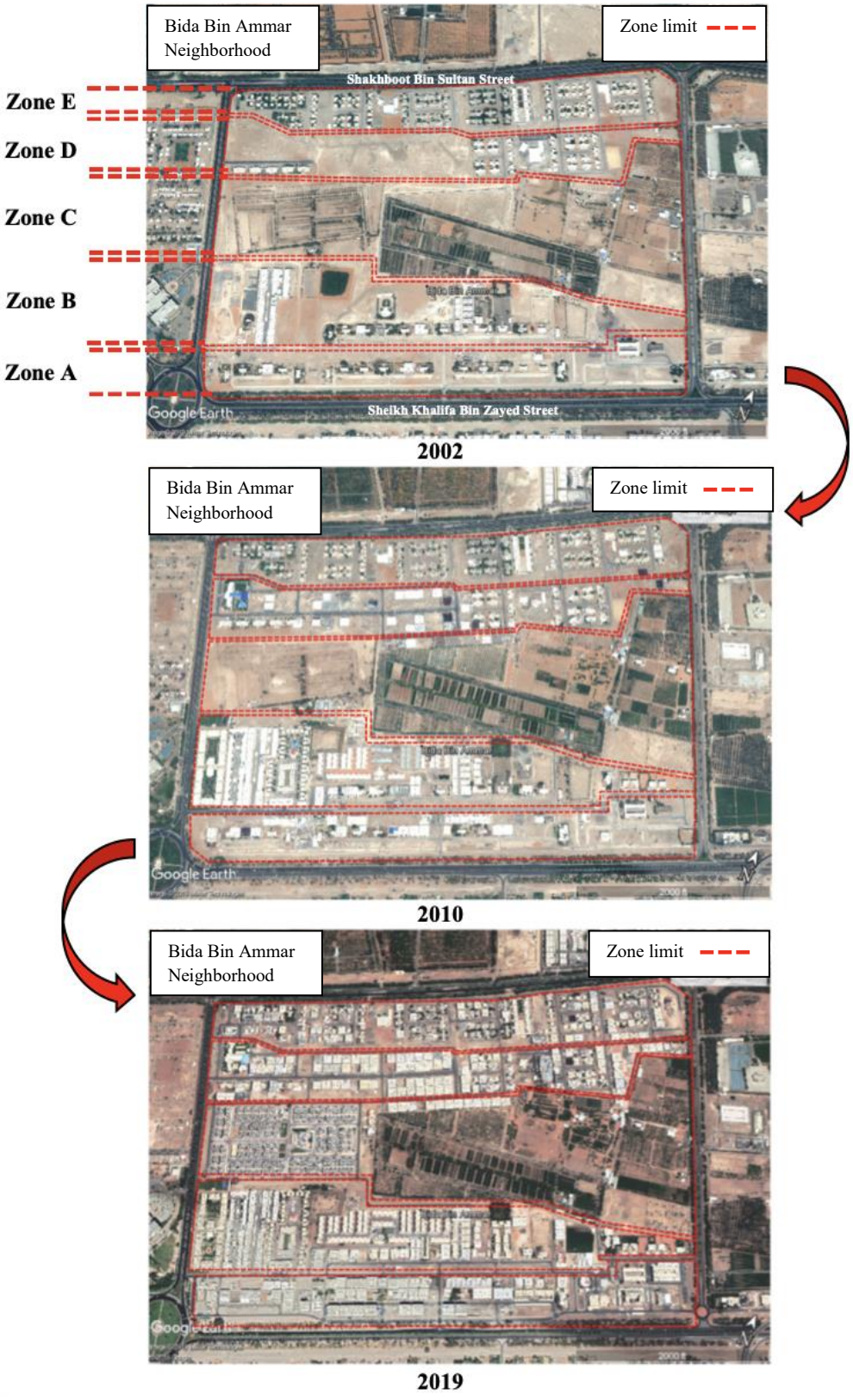


Figure 32: Timeline of the Urban Transformation of Bida Bin Ammar Neighborhood from 2002 to 2019 (Google Earth Maps, 2019).

Chapter 5: Analysis of the Applied Tools for Urban Densification in Bida Bin Ammar Neighborhood in Asharej District

5.1 Introduction

This chapter identifies tools on which urban densification has taken place between 2010 and 2019 in Bida Bin Ammar neighborhood in Asharej district. Four urban densification tools are identified in the conceptual framework (mixed-use, mixed housing types and tenures, intensification, and infill), and each tool is measured by its indicators for each of the five zones. See Table 1 in Appendix A to review the conceptual framework of urban densification tools. Moreover, the chapter highlights the methods of densification used in each of the study zones and maps all of the changes that happened in Bida Bin Ammar in Asharej from 2010 to 2019. Also, the author provided the findings for each of the study zones individually. Regarding data interpretation, the author generated maps of the area for the years of 2010 and 2019, as well as figures with detailed information regarding the properties that have undergone densification since 2010. Furthermore, it is important to note that this study focuses purely on urban densification tools that were applied in Bida Bin Ammar in Asharej since 2010. The study further investigates in the following chapter, the impacts of the applied urban densification tools in the Bida Bin Ammar neighborhood in Asharej district in 2019 on the social sustainability principles.

5.2 Applied Tools of Urban Densification in Bida Bin Ammar in Asharej District

5.2.1 Mixed-Use

Horizontal Mixed-Use

By analyzing the land-use map in 2019, it is observed that Bida Bin Ammar neighborhood in Asharej district contains a mixture of various community facilities such as commercial residential housing, mixed-use blocks, and community facilities (masjid, retails, restaurants, school, clubs, farms, hospital, medical clinics, and police station). The land use map of Bida Bin Ammar neighborhood demonstrates the distribution of the facilities in the site of the study area, which was divided by the author into five Zones (A, B, C, D, and E). See Figure 33 for more details.

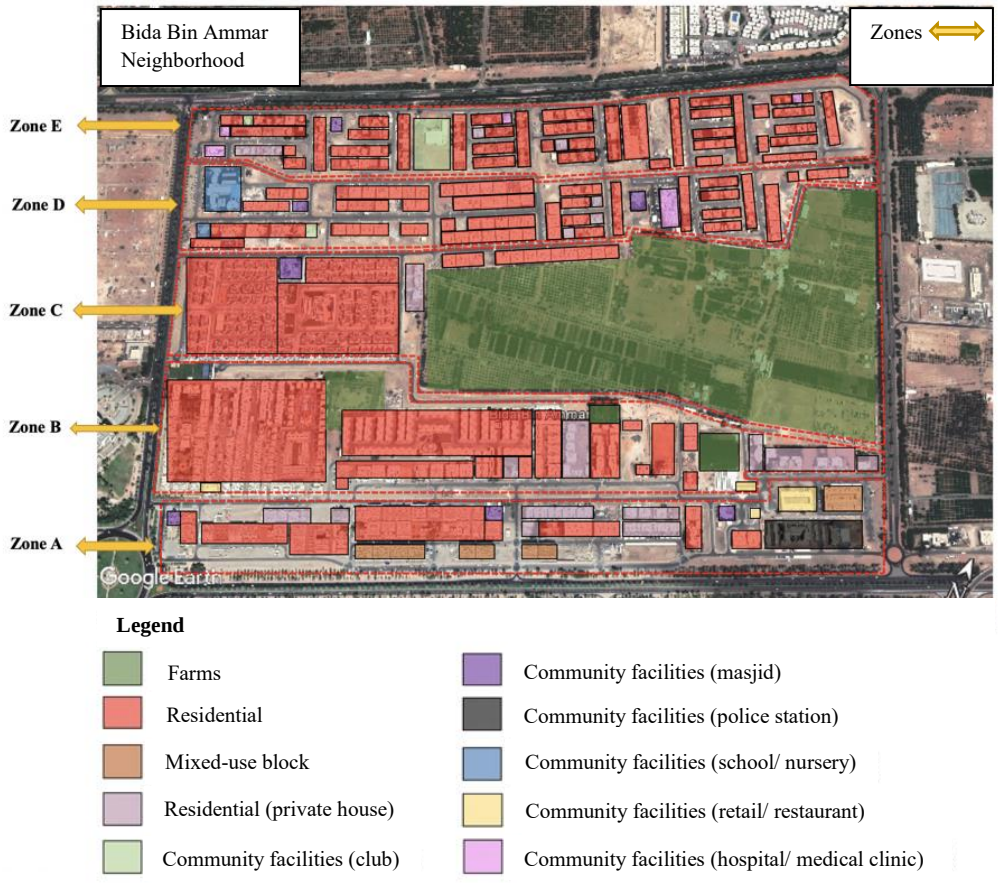


Figure 33: Land-Use Map of Bida Bin Ammar Neighborhood in Asharej District (Google Earth Maps, 2019).

Zone A contains different uses in different buildings (commercial, residential housing, private houses, mixed-use blocks, and community facilities including, three masjids, retails, restaurants, and police station), where Zone B consists of a mixture of different single-use buildings with different functions and activities (commercial, residential housing, private houses, farms, and community facilities including retails, and restaurants), as shown in Figure 33. Moreover, Zone C is mostly characterized by the existence of farms. In addition, Zone C contains different uses in different buildings (commercial, residential housing, private houses, farms, and masjid). Refer to Figure 33. Besides, Zone D contains different uses in different buildings (commercial, residential housing, private houses, and community facilities including, a school, nursery, health club, hospital, and two masjids). Furthermore, as displayed in Figure 33, Zone E consists of a mixture of different single-use buildings with different functions and activities (commercial, residential housing, private houses, and community facilities like two medical clinics, masjid, and two clubs). Through the analysis of land-use map for the year of 2019, and the generated land use map that was done by the author for the five zones in Bida Bin Ammar neighborhood in Asharej district, it is realized that providing a mixture of different single-use buildings, and community facilities with various functions and activities is partially applied in Zones A, and D, and weakly applied in Zones B, C, and E. See Table 1. Mixed-use (horizontal mixed-use) tool was assessed by the Likert Scale for the five zones in Bida Bin Ammar neighborhood, where the value (1) refers to not applied classification, and the value of (5) refers to fully applied classification. Then, by adding the two values that are indicating for partially applied in Zones A, and D (3+3=6), and the three values that are indicating for weakly applied classification in Zones B, C, and E (2+2+2 =6), the result is equal to 12. By dividing 12 by 5 (5 is the maximum number of the

classification application in the five zones as shown in Table 1, the result is 2.4, which is approximately matching with the value assigned to partially applied classification. Therefore, horizontal mixed-use through provision of a mixture of different single-use buildings, is partially applied in Bida Bin Ammar neighborhood in Asharej district.

Table 1: Mixed-Use: Horizontal Mixed-Use.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Vertical Mixed-Use

Through the observations and the analysis of Google Earth map for the year of 2019 for Bida Bin Ammar neighborhood in Asharej district, it is noticed that a mixed-use multi-story blocks that have different uses (residential, offices, and retails) within a single building are only available in Zone A. However, mixed-use multi-story blocks are not applied in Zones B, C, D, and E. See Figure 33. Moreover, more public uses are provided in the lower floor (retail, shops, restaurants, library, and banks), and more private uses on the upper floors (residential units). Refer to Figure 34 for clarification. By studying Google Earth map in 2019 in the five zones in Bida Bin Ammar neighborhood, and from the field observations, it is recognized that the availability of mixed-use multi-story blocks that have different uses within a single building is partially applied in Zone A, and not applied in Zones B, C, D, and E. See Table 2. By adding the value that is indicating for partially applied in Zone A (3), and the four

values that are indicating for weakly applied classification in Zones B, C, D, and E (1+1+1+1=4), the result is equal to 7. By dividing 7 by 5, the result is 1.4, which is approximately matching with the value assigned to weakly applied classification. Therefore, vertical mixed-use is weakly applied in Bida Bin Ammar neighborhood in Asharej district.

Table 2: Mixed-Use: Vertical Mixed-Use.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Figure 34: Mixed-Use Multi-Story Blocks (a, b, c) in Zone A (Google Earth Maps, 2019).

Mixed-Use Walkable Areas

By studying the five zones of Bida Bin Ammar neighborhood, it is explored that only Zone A combines both horizontal and vertical mix of uses. The other four Zones (B, C, D, and E) include only horizontal mixed-use. Vertical mixed-use is not applied in Zones B, C, D, and E, since there is no provision of mixed-use multi-story blocks in these zones. Refer to Figure 33 for clarification. Therefore, by analyzing Google Earth map in 2019 in the five zones in Bida Bin Ammar neighborhood, and from the field observations, it is observed that the availability of mixed-use multi-story blocks that have different uses within a single building is partially applied in Zone A, and not applied in Zones B, C, D, and E. See Table 3. By adding the value that is indicating for partially applied in Zone A (3), and the four values that are indicating for weakly applied classification in Zones B, C, D, and E (1+1+1+1=4), the result is equal to 7. By dividing 7 by 5, the result is 1.4, which is approximately matching with the value assigned to weakly applied classification. Thus, mixed-use walkable areas densification tool is weakly applied in Bida Bin Ammar neighborhood in Asharej district.

Table 3: Mixed-Use: Mixed-Use Walkable Areas.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Finally, Table 4 demonstrates the partial application of horizontal mixed-use, and the weak application of vertical mixed-use, and mixed-use walkable areas. Yet, by adding the value for partially applied for horizontal mixed-use (3), and the two values that are indicating for weakly applied classification in vertical mixed-use, and mixed-use walkable areas (2+2=4), the result is equal to 7. By dividing 7 by 5, the result is 1.4, which is approximately matching with the value assigned to weakly applied classification. Thus, mixed-use densification tool is weakly applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 22.

Table 4: Mixed-Use (Overall Assessment).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Horizontal Mixed-Use					
Vertical Mixed-Use					
Mixed-Use Walkable Areas					

5.2.2 Mixed Housing: Tenure

Indicator 1: Providing the Ability for Families to Own or Rent Mix of Housing Forms and Tenures

From the field observations in Bida Bin Ammar neighborhood, it is clear that providing the ability to own houses by the families is not applied in all zones. The only form of tenure that prevails in Bida Bin Ammar neighborhood is rent, and it is common in the five Zones (A, B, C, D, and E). In Zone A, Figure 35 shows an example of two residential apartment blocks for rent and another residential commercial block that is under construction. Besides, Figure 36 in Zone B presents a residential apartment

block for rent and other residential units for rent within a gated community. These residential dwellings can be rented from First Abu Dhabi Bank (FAB), as shown on the lessening signboards in Figure 36. Additionally, in Zone C, as shown in Figure 37, there are residential units for rent in a gated community and other two residential apartment blocks for rent. Also, there is a residential-commercial block under construction. Furthermore, in Zone D, there are several examples of apartment blocks and commercial villas that are for rent. Refer to Figures 38 and 39. Moreover, Figure 40 in Zone E displays residential units for rent in a gated community, and one apartment block for rent also. Table 5 shows that by adding the five values that are indicating to not applied classification in the five zones (1+1+1+1+1=5), the result is equal to 5. By subdividing the result by 5, the result is equal to 1, which matches with the value assigned to the not applied classification. Therefore, providing the ability to own houses by the families (Indicator 1) is not applied in the Bida Bin Ammar neighborhood in Asharej district.

Table 5: Mixed Housing: Tenure (Ind.1: Providing the Ability for Families to Own or Rent Mix of Housing Forms and Tenures).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Figure 35: Apartment Blocks for Rent (a, b, c) in Zone A (Residential Investment Blocks).

a)

b)

Figure 36: Residential Investment Blocks in Zone B (a: Residential Units for Rent in a Gated Community, and b: Apartment Blocks for Rent).

a)

b)

Figure 37: Residential Investment Blocks in Zone C (a: Residential Units for Rent in a Gated Community, and b: Apartment Blocks for Rent).

a)

b)

Figure 38: Examples of Residential Investment Blocks in Zone D (a: Commercial Villa for Rent, and b: Commercial Villa that is Under Construction).

a)

b)

Figure 39: Residential Investment Blocks in Zone D (a, and b: Apartment Blocks for Rent).

a)

b)

Figure 40: Residential Investment Blocks (a, b) in Zone E (a: Apartment Blocks for Rent, and b: Residential Units for Rent in a Gated Community).

Indicator 2: Providing Private and Social Housing as a Part of the Development Project

By studying the site of Bida Bin Ammar neighborhood through the field observations, and the analysis of the Google Earth maps, it is realized that the presence of social housing as a part of the development project is not applied in all the zones in Bida Bin Ammar neighborhood. However, the provision of private housing is applied variously in the five zones. Refer to the land use map in Figure 33 for clarification. Therefore, the mix between private and social housing (Indicator 2) is not applied in the Bida Bin Ammar neighborhood. See Table 6.

Table 6: Mixed Housing: Tenure (Ind.2: Providing Private and Social Housing as a Part of the Development Project).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

At the end, Table 7 shows that the ability to own or rent by the families (Indicator 1), and the provision of private and social housing as a part of the development project (Indicator 2) are not applied. Then, by adding the two values that are indicating for not applied classification for indicators 1 and 2 (1+1=2), the result is equal to 2. By dividing 2 by 5, the result is 0.4, which is approximately matching with the value assigned to not applied classification. Thus, mixed housing tenure is not applied in Bida Bin Ammar neighborhood in Asharej district.

Table 7: Mixed Housing: Tenure (Overall Assessment).

	Fully Applied (5)	Significantly Applied (4)	Partially Applied (3)	Weakly Applied (2)	Not Applied (1)
Ind. 1: Providing the ability to own or rent by the families (mix of forms and tenures of housing).					
Ind. 2: Providing private and social housing as a part of the development project.					

5.2.3 Mixed Housing: Types

Based on the field observations in the site of Bida Bin Ammar neighborhood, there is a presence of different housing types and opportunities (single-family detached dwellings, semi-detached dwellings, walk-ups apartment blocks, mixed-use blocks, and residential dwellings within various gated communities). Figure 41 in Zone A shows different examples of the housing types including, mixed-use block, one hundred percent apartment block, a detached single-family house, a detached private villa, one hundred percent apartment block, and detached commercial villas. Moreover, in Zone B Figure 42 displays a variety of housing types such as residential dwellings within a gated community, one hundred percent apartment block, a detached single-family house, and semi-detached dwellings. Also, the same phenomenon was observed in other Zones (C, D, and E). Besides, there is a provision of mixed housing types and opportunities in Bida Bin Ammar neighborhood in the five zones, but the mixed-use blocks as a type of housing are only applied in Zone A. As a result, the

provision of mixed housing types is significantly applied in Zone A, and partially applied in Zones B, C, D, and E. Table 8 shows that by adding the value that is indicating to significantly applied classification in Zone A (4), and the four values that are indicating to partially applied classification in Zones B, C, D, and E (3+3+3+3=12), the result is equal to 16. By subdividing the result by 5, the result is equal to 3.2, which is approximately matching with the value assigned to significantly applied classification. Therefore, mixed housing types is significantly applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 9.

Table 8: Mixed Housing: Types.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

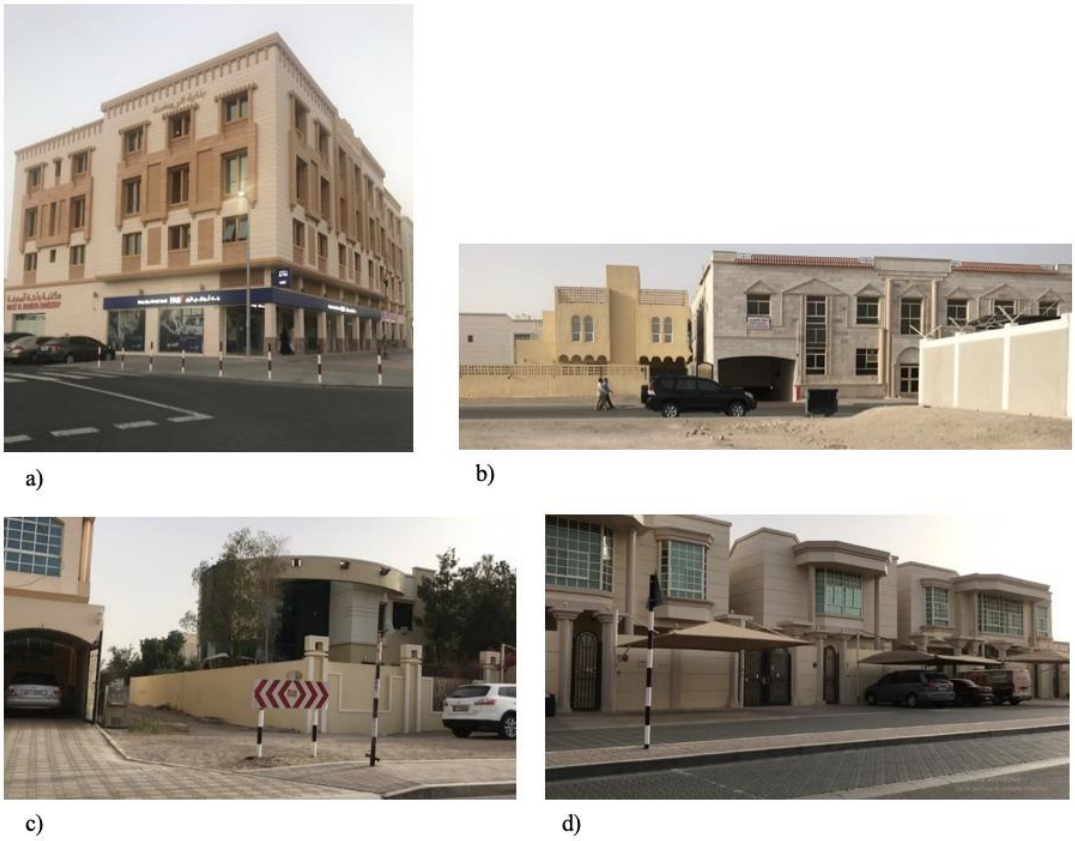


Figure 41: Mixed Housing Types in Zone A (a: Mixed-Use Block. b: Detached Single Family House, and 100% Apartment's Block. c: Detached Private Villa. d: Detached Commercial Villas).

a)

b)

Figure 42: Mixed Housing Types in Zone B (a: Residential Dwellings within a Gated Community, in the Middle an Old Detached Single-Family House, and Right Side: 100% Apartments Block. b: Semi-Detached Dwellings).

Finally, Table 9 demonstrates that mixed housing tenure is not applied, while mixed housing types is significantly applied in Bida Bin Ammar neighborhood. Then, by adding the value that is indicating for not applied for mixed housing tenure (1), and the value that is indicating for significantly applied classification for mixed housing types (4), the result is equal to 5. By dividing 5 by 2, the result is 2.5, which is approximately matching with the value assigned to partially applied classification. Thus, mixed housing tool is partially applied in Bida Bin Ammar neighborhood in Asharej district. See Table 22.

Table 9: Mixed Housing (Tenure and Types).

	Fully Applied (5)	Significantly Applied (4)	Partially Applied (3)	Weakly Applied (2)	Not Applied (1)
Mixed Tenure.					
Mixed Types.					

5.2.4 Intensification: Subdivision of Property

Based on the analysis and the observations that are done in the study area, parcel subdivision of land into two or further parcels (Indicator 1), is not applied in all the five zones. See Table 10. As a result, the tool of subdivision of properties is not applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 22.

Table 10: Intensification: Subdivision of Property Assessment.

	Fully Applied (5)	Significantly Applied (4)	Partially Applied (3)	Weakly Applied (2)	Not Applied (1)
Ind.1: Allowance to subdivide a large parcel of land into two or further parcels.					

5.2.5 Intensification: Consolidation

In Zone A, two lots of land were joined together to create a new single lot. Figure 43 clarifies the case by showing the transformation that happened between 2010 and 2019. Two separate lands specified for a single-family house were consolidated under one parcel of land that contains one hundred percent apartment block. Besides, through the comparison between Google Earth maps in 2002, 2010, and 2019 at Zone

B, it was noted that two titles of lands were joined to become one land. The two titles of lands were specified for single family houses, then they were demolished to construct a new apartment block that occupies one hundred percent built up area on the consolidated land. See Figure 44. Moreover, two parcels of lands that were occupying single-family houses in Zone E are consolidated into one parcel of land that is occupying recently one hundred percent apartment block. Refer to Figure 45. By analyzing Google Earth maps between 2010 and 2019 in the five zones in Bida Bin Ammar neighborhood, it is recognized that consolidation through joining together more than one lot to create a new single lot is weakly applied in Zones A, B, and E, and not applied in Zones C and D. See Table 11. By adding the three values that are weakly applied in Zones A, B, and E (2+2+2=6), and the two values that are indicating for not applied classification in Zones B, and C (1+1=2), the result is equal to 8. By subdividing the value 8 by 5, the result is 1.6, which is approximately matching with the value assigned to weakly applied classification. Therefore, consolidation through joining together more than one lot to create a new single lot is weakly applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 22.

Table 11: Intensification: Consolidation Assessment.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

a)

b)

Figure 43: Intensification: Consolidation in Zone A. (a, b) Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

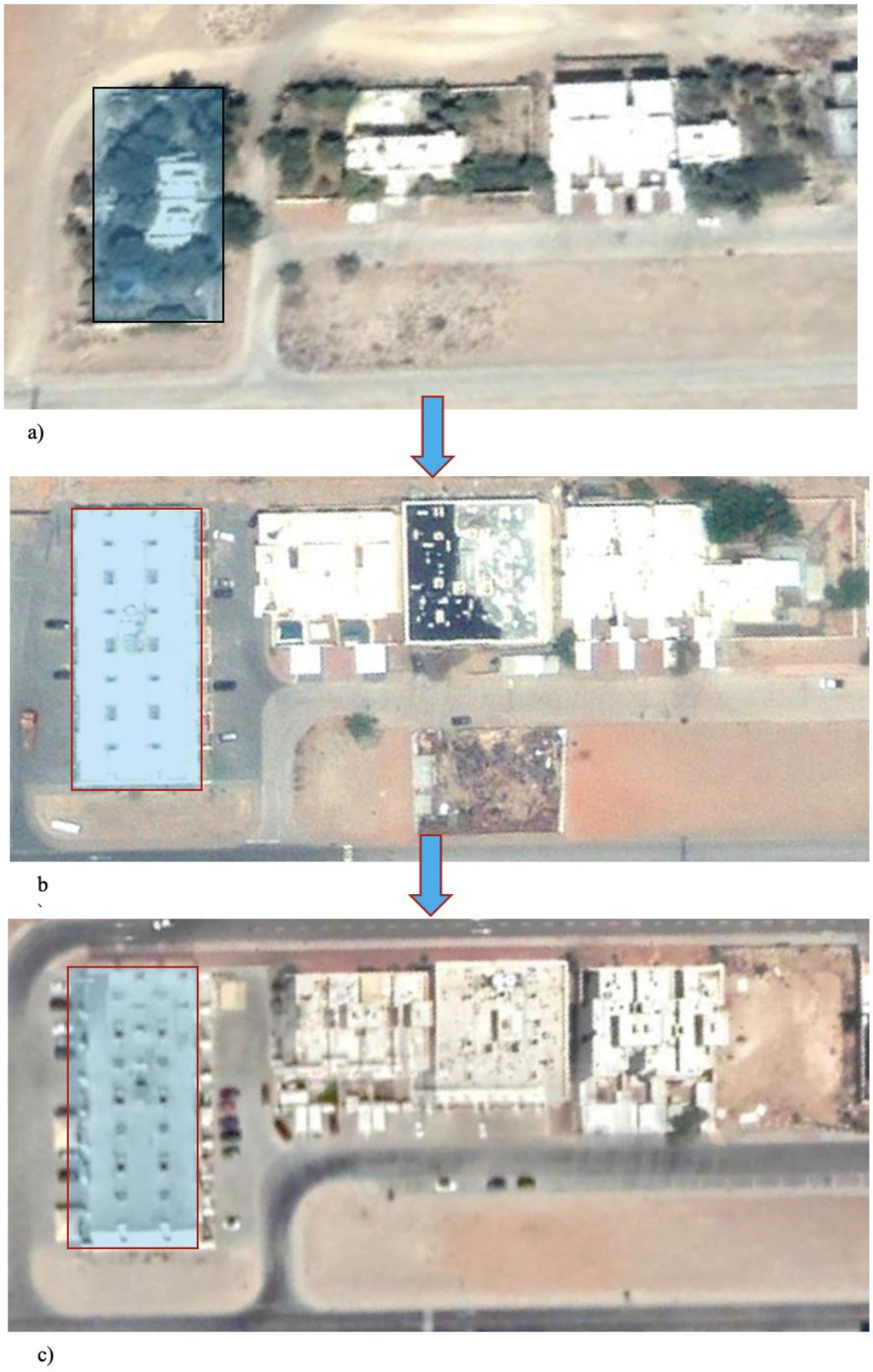


Figure 44: Intensification: Consolidation in Zone B. (a, b, c) Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

a)

b)

Figure 45: Intensification: Consolidation in Zone E. (a, b) Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

5.2.6 Intensification: Vertical Extension

By studying the site of Bida Bin Ammar neighborhood in Asharej district, the author discovered that allowing to increase the height of an existing building, is not applied in all the five zones. Refer to Table 12.

Table 12: Intensification: Vertical Extension Assessment.

	Fully Applied (5)	Significantly Applied (4)	Partially Applied (3)	Weakly Applied (2)	Not Applied (1)
Ind.1: Allowance to increase the height of an existing building in all zones.					

5.2.7 Intensification Through Horizontal Extension: Increase of Bulk Rights (Indicator A: Adding Extra Area to the House by Extending Current Balconies, and Closing the Current Balconies)

Figure 46 in Zone A shows two locations of single-family houses that extended their balconies to utilize it for extra space. Moreover, Zone B in Figure 47 has the same situation. A balcony in an old single-family house was extended to build an extra room. Besides, in Zone D, Figure 48 represents two single-family houses that extended their balconies to add extra area to the house. Refer to Figure 49. In Zone E, a balcony of a single-family house was closed to utilize extra space, as shown in Figure 50. Also, Figures 51, 52, 53, 54, 55, and 56 are showing other different locations in Zone E were building extra rooms or extending current balconies. However, building extra rooms or extending current balconies is not applied in Zone C. By studying Google Earth map in 2019 in the five zones in Bida Bin Ammar neighborhood, and from the field observations, it is recognized that adding extra area to the house by extending current

balconies (closing the current balconies) is partially applied in Zone E, weakly applied in Zones A, B, and D, and not applied in Zone C. See Table 13. By adding the value that is indicating for partially applied classification in Zone E (3), and the three values that are indicating for weakly applied in Zones A, B, and D (2+2+2=6), and the value that is indicating for not applied classification in Zone C (1), the result was equal to 10. By subdividing the value 10 by 5, the result is 2, which is matching with the value assigned to weakly applied classification. Therefore, increase the bulk rights by extending current balconies (closing the current balconies) is weakly applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 15.

Table 13: Intensification through Horizontal Extension: Increase of Bulk Rights - (Assessment of Indicator A).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Figure 46: Intensification through Horizontal Extension (a, b): Increase of Bulk Rights in Zone A (Indicator A), Map 2019 (Google Earth Maps, 2019).

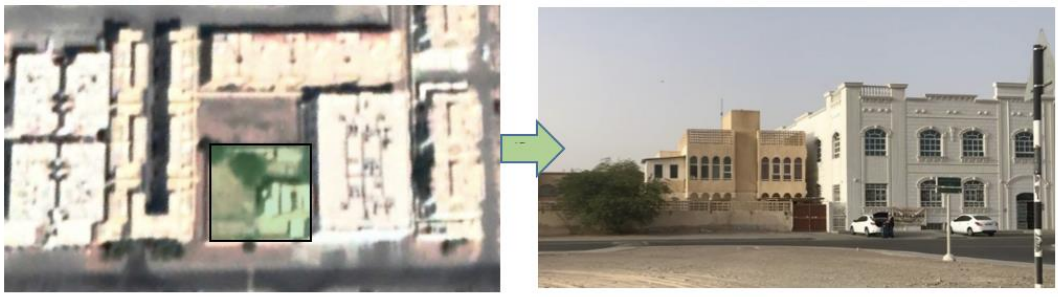


Figure 47: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone B (Indicator A), Map 2019 (Google Earth Maps, 2019).

Figure 48: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone D (Indicator A), Map 2019. Location No. 1 (Google Earth Maps, 2019).

Figure 49: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone D (Indicator A), Map 2019. Location No. 2 (Google Earth Maps, 2019).

Figure 50: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 1 (Google Earth Maps, 2019).

Figure 51: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 2 (Google Earth Maps, 2019).

Figure 52: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 3 (Google Earth Maps, 2019).

Figure 53: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 4 (Google Earth Maps, 2019).

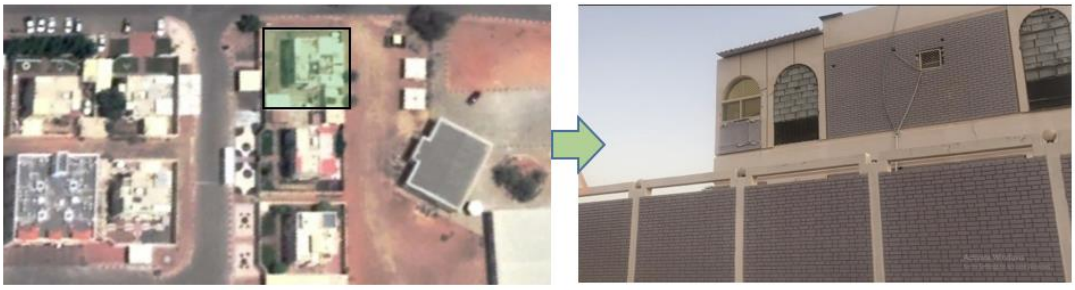


Figure 54: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 5 (Google Earth Maps, 2019).

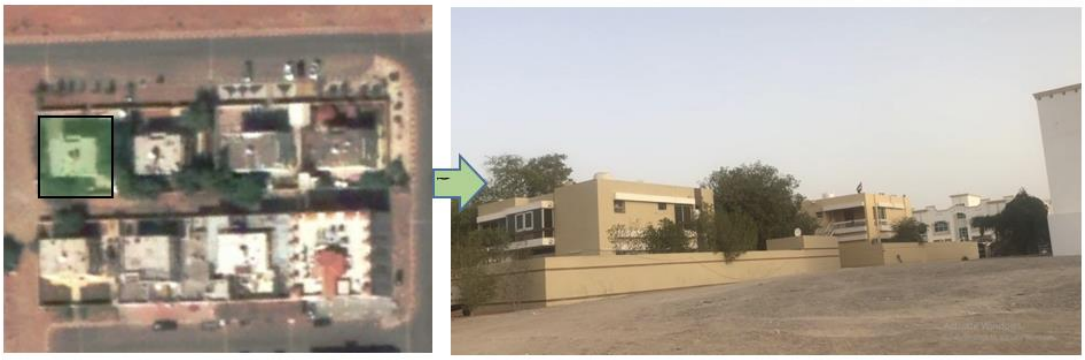


Figure 55: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 6 (Google Earth Maps, 2019).

Figure 56: Intensification through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator A), Map 2019. Location No. 7 (Google Earth Maps, 2019).

5.2.8 Intensification Through Horizontal Extension: Increase of Bulk Rights (Indicator B: Increasing the Bulk (Mass) Rights of a Specific Property by Extending Buildings' Front and Side Facades, and Rear Extension for Single-Family Houses)

In Zone A, Figure 57 displays that there was an increase in the bulk rights of the property because of the extension that was applied on the side yard of the house. In addition, the mass of the building displayed in Figure 58 in Zone C was increased by applying the extension on the side yard of the house (integrated with the boundary wall of the dwelling). Moreover, in Zone D, an external unit was constructed in the main homes' front yard. This extended unit was integrated with the homes' front boundary wall, as shown in Figure 59. Furthermore, in Zone E, two additional

detached structures were constructed in the main homes' front yard. See Figure 60. However, increasing the bulk (mass) rights of a specific property by extending buildings' front and side facades, and rear extension for single-family houses, was not applied in Zone B. From the analysis of the Google Earth map in 2019, and the observations of the study area, it is explored that increasing the bulk (mass) rights pertaining to a specific property by extending buildings' front and side facades, and rear extension for single-family houses, is weakly applied in Zones A, C, D, and E, and not applied in Zone B. Check Table 14. By adding the four values that are indicating for weakly applied in Zones A, C, D, and E (2+2+2+2=8), and the value that is indicating for not applied classification in Zone B (1), the result is equal to 9. By subdividing the value 9 by 5, the result is 1.8, which is approximately matching with the value assigned to weakly applied classification. Therefore, increasing the bulk (mass) rights of a specific property by extending buildings' front and side facades, and rear extension for single-family houses, is weakly applied in Bida Bin Ammar neighborhood in Asharej district. See Table 15.

Table 14: Intensification Through Horizontal Extension: Increase of Bulk Rights - (Assessment of Indicator B).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Figure 57: Intensification Through Horizontal Extension: Increase of Bulk Rights in Zone A (Indicator B), Map 2019 (Google Earth Maps, 2019).

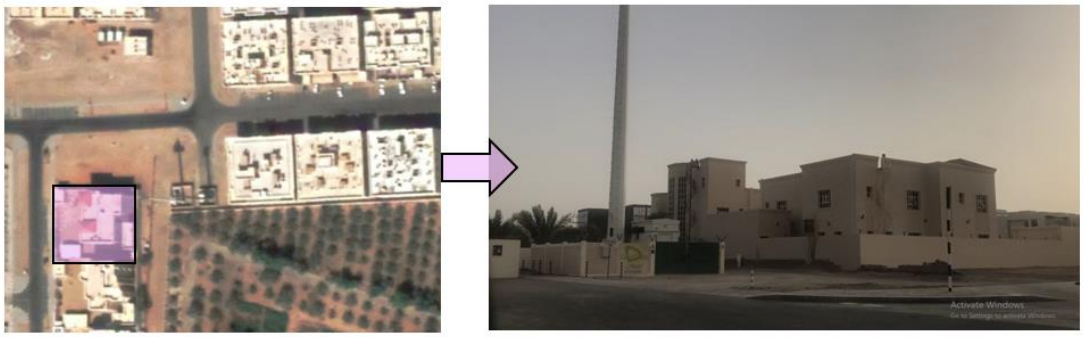


Figure 58: Intensification Through Horizontal Extension: Increase of Bulk Rights in Zone C (Indicator B), Map 2019 (Google Earth Maps, 2019).

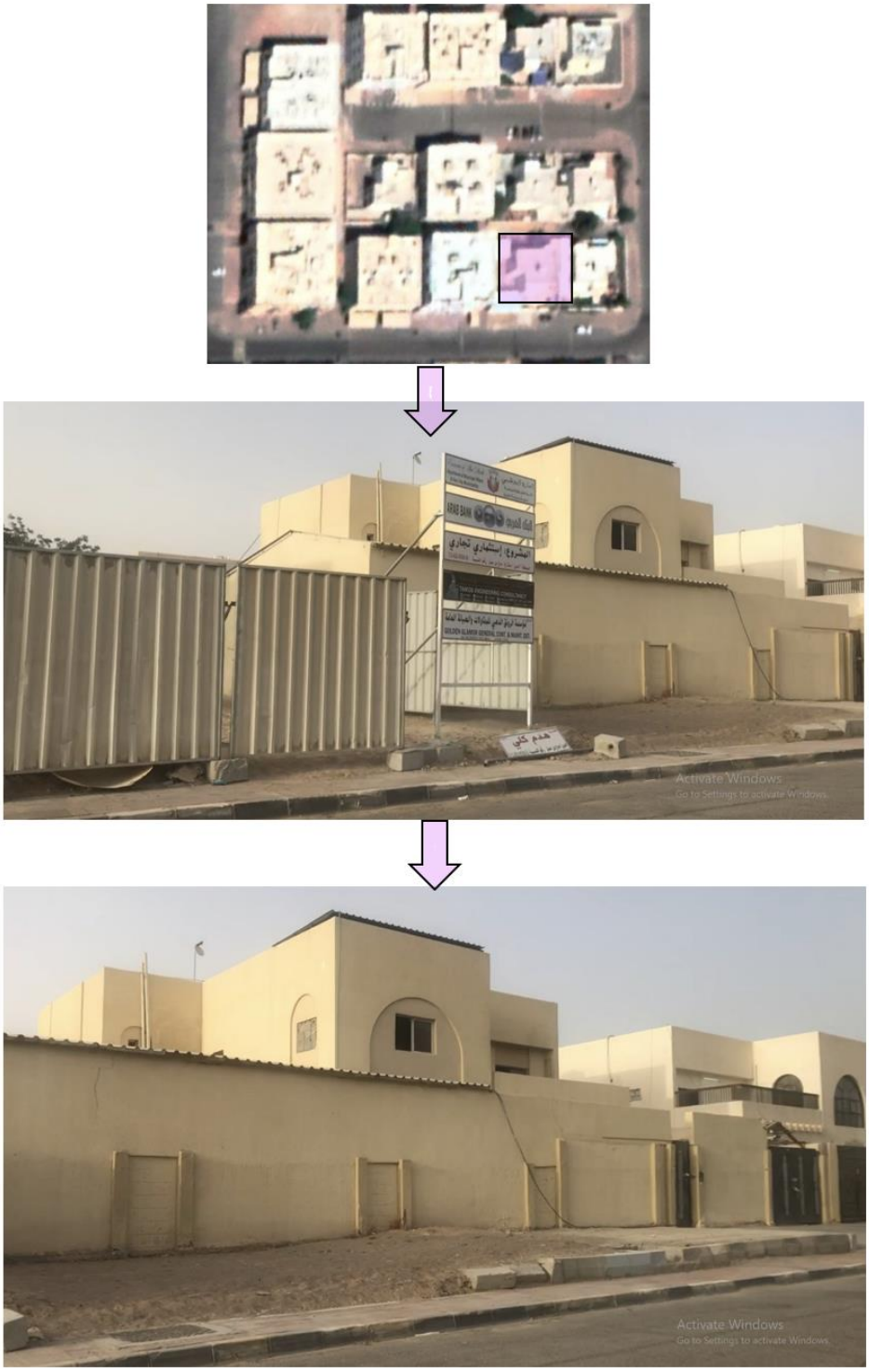


Figure 59: Intensification Through Horizontal Extension: Increase of Bulk Rights in Zone D (Indicator B), Map 2019 (Google Earth Maps, 2019).

Figure 60: Intensification Through Horizontal Extension: Increase of Bulk Rights in Zone E (Indicator B), Map 2019 (Google Earth Maps, 2019).

Lastly, Table 15 presents that the ability to add extra area to the house by extending current balconies/closing the current balconies (Indicator a), and increasing the bulk (mass) rights of a specific property by extending buildings' front and side facades, and rear extension for single-family houses (Indicator b) are weakly applied. By adding the two values that are indicating for weakly applied classification for Indicators 1 and 2 (2+2=4), the result is equal to 4. By dividing 4 by 2, the result is 2, which is matching with the value assigned to weakly applied classification. Thus, increase of bulk rights densification tool is not applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 17.

Table 15: Intensification through Horizontal Extension: Increase of Bulk Rights (Assessment of Indicators A and B).

	Fully Applied (5)	Significantly Applied (4)	Partially Applied (3)	Weakly Applied (2)	Not Applied (1)
Ind. A: Adding extra area to the house by extending current balconies (closing the current balconies).					
Ind. B: Increasing the bulk (mass) rights of a specific property by extending buildings' front and side facades, and rear extension for single-family houses.					

5.2.9 Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling

An additional unit that is externally attached to the existing single-family house was provided in Zone A, as shown in Figure 61. Also, a detached structure was located in the side yard of an existing dwelling. See Figure 62. In Zone B, Figure 63 displays an old single-family house that has a detached external structure that is located in the main home's side yard. Moreover, a detached external unit to an existing single-family house is located in the homes' back yard. This case was observed in Zone D. Refer to Figure 64. Furthermore, in Zone E, two additional external detached external units were constructed in the main homes' back yard, as shown in Figures 65, and 66. On the other hand, providing additional units to the existing house, either detached or attached to the main house, is not applied in Zone C. Through the study of Google Earth maps between 2010 and 2019 in the five zones in Bida Bin Ammar neighborhood, it is explored that providing additional units to the existing house (either

detached structures or attached external structures) is weakly applied in Zones A, B, D, and E, and not applied in Zone C. See Table 16. By adding the four values that are weakly applied in Zones A, B, D, and E (2+2+2+2=8), and the value that is indicating for not applied classification in Zone C (1+1=2), the result is equal to 9. By subdividing the value 9 by 5, the result is 1.8, which is approximately matching with the value assigned to weakly applied classification. Therefore, attached/detached second dwelling densification tool is weakly applied in Bida Bin Ammar neighborhood in Asharej district. See Table 17.

Table 16: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

Figure 61: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling in Zone A – Map 2019. Location No. 1 (Google Earth Maps, 2019).

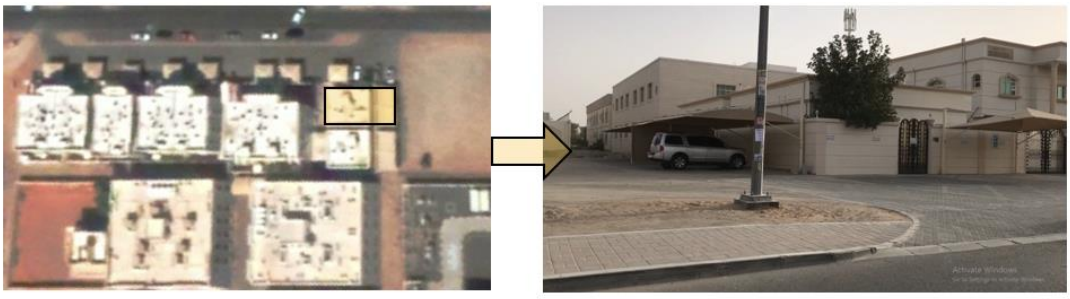


Figure 62: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling in Zone A – Map 2019. Location No. 2 (Google Earth Maps, 2019).

Figure 63: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling in Zone B – Map 2019 (Google Earth Maps, 2019).

Figure 64: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling in Zone D – Map 2019 (Google Earth Maps, 2019).

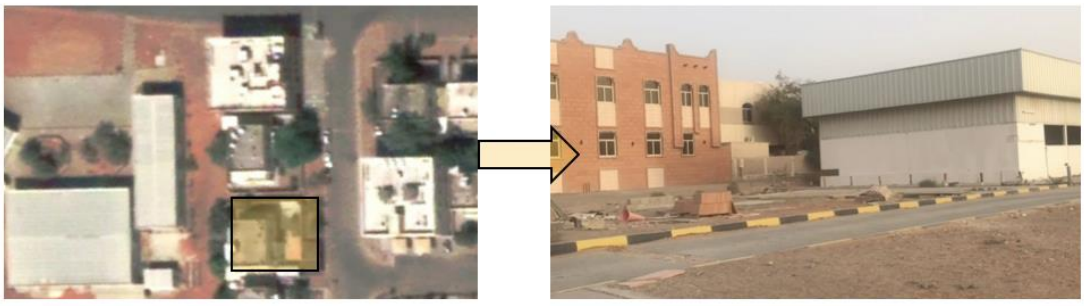


Figure 65: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling in Zone E – Map 2019. Location No. 1 (Google Earth Maps, 2019).

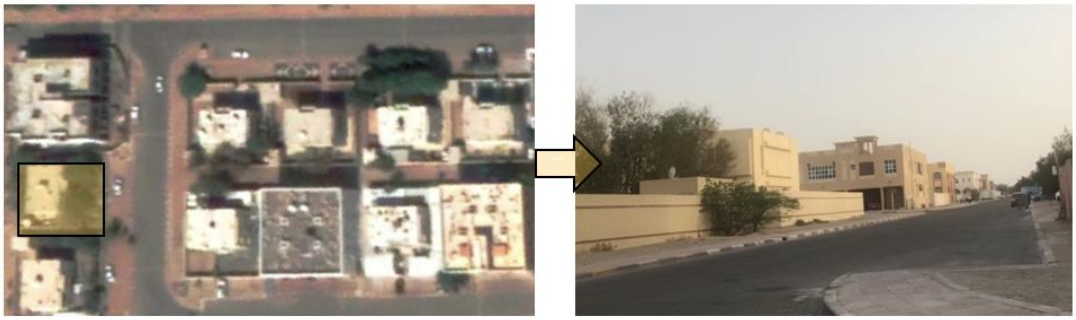


Figure 66: Intensification Through Horizontal Extension: Attached/ Detached Second Dwelling in Zone E – Map 2019. Location No. 2 (Google Earth Maps, 2019).

Lastly, increase of bulk rights is weakly applied, and attached/detached second dwelling tools is not applied as show in Table 17. Then by adding the two values that are indicating for weakly applied and not applied classification (2+2=4), the result is equal to 4. By dividing 4 by 2, the result is 2, which is matching with the value assigned to weakly applied classification. As a result, horizontal extension tool is weakly applied in Bida Bin Ammar neighborhood in Asharej district. See Table 18.

Table 17: Intensification Through Horizontal Extension (Overall Assessment).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Increase of Bulk Rights.					
Attached/ Detached Second Dwelling.					

Ultimately, Table 18 displays that subdivision of property, consolidation, vertical extension, and horizontal extension are not applied. Thereafter, by adding the four values that are indicating for weakly applied of consolidation, and not applied classification in subdivision of property, vertical extension, and horizontal extension (1+2+1+1=5), the result is equal to 5. By dividing 5 by 5, the result is 1, which is

matching with the value assigned to not applied classification. Thus, intensification tool is not applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 22.

Table 18: Intensification (Overall Assessment).

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Subdivision of Property.					
Consolidation.					
Vertical Extension.					
Horizontal Extension.					

5.2.10 Infill Development: Development of Vacant Parcels

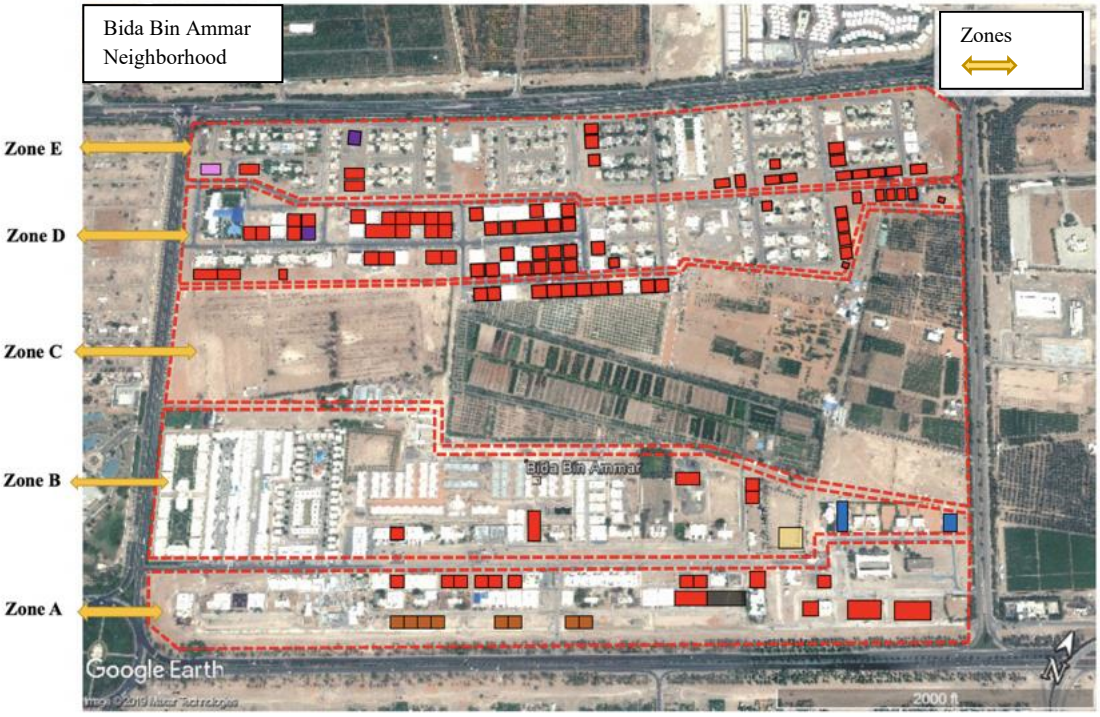
Another form of urban densification in Bida Bin Ammar community in Asharej district that is frequently prevalent is the infill strategy (by filling in vacant lots with shared spaces). Figure 67 shows the transformation that happened in Bida Bin Ammar towards infill development. Map 1 in Figure 67 displays the infill method that was applied in all the five Zones (A, B, C, D, and E) in 2010. Then, map 2 shows the current situation in 2019 after the infill that was applied. Finally, map 1 in Figure 68 clarifies the locations of the infill that is going to be applied in Bida Bin Ammar by Al Ain 2030 plan. See map 2 in Figure 68. Infill strategy as a densification tool that had been applied in Bida Bin Ammar is explained separately in each zone of the five Zones (A, B, C, D, and E). In Zone A, the infill was applied for the unused land within developed areas with multi stories (G+3) mixed use blocks where the ground floor and mezzanine

are commercial, first, second, and the third floors are residential. This form of infill is located on the strip that is facing the main street of the development. In addition, infill was applied in Zone A on the brownfield urban sites that had previous development on them. The infill was done by one hundred percent apartment blocks (residential), and police station. See Figure 67 (map 1 – Zone A). Furthermore, infill was applied in Zone B on the brownfield urban sites that had previous development on them. The infill was done by one hundred percent apartment blocks, and two private houses (residential), and community facility (restaurant). Refer to Figure 67 (map 1 – Zone B). In Zone C, the infill was done on unused lands that were remained vacant, by one hundred percent apartment blocks (residential), as shown in Figure 67 (map 1 – Zone C). Besides, Figure 67 in Zone D (map 1) show up that the infill was applied on unused lands that remained vacant by one hundred percent apartment blocks, and community facility (masjid). Finally, in Zone E the method of infill was used on an unused lands that remained vacant, by one hundred percent apartment blocks, and community facilities (masjid, and medical center). Also, infill strategy was implemented on brownfield urban sites that had previous development on them, by one hundred percent apartment blocks. See Figure 67 (map 1 – Zone E). As a result, through the analysis of Google Earth maps between 2010 and 2019 in the five Zones in Bida Bin Ammar neighborhood, it is noticed that filling the vacant places in the community was fully applied in Zone D, significantly applied in Zone A, partially applied in Zone E, and weakly applied in Zones B, and C. Refer to Table 19. By adding the value (4) that is significantly applied in Zone D, and the two values that are indicating for partially applied in Zones A and E (3+3=6), and lastly the two values that are indicating for weakly applied classification in Zones B and C (2+2 =4), the result is equal to 14. By subdividing 14 by 5, the result is 2.8, which is approximately matching with the value

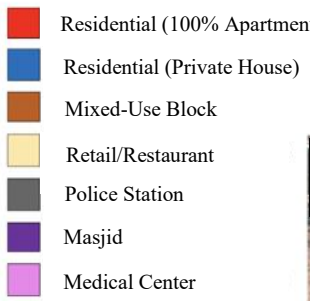
assigned to partially applied classification. Therefore, development of vacant parcels densification tool is partially applied in Bida Bin Ammar neighborhood in Asharej district. See Table 21.

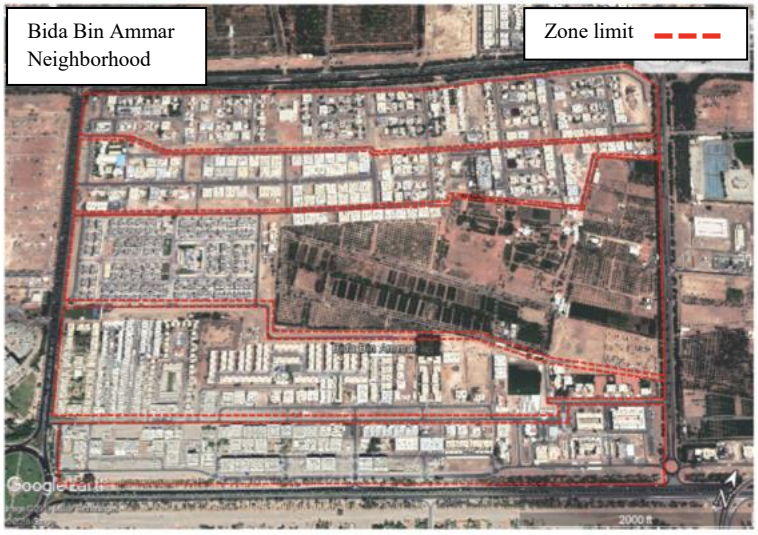
Table 19: Infill Development: Development of Vacant Parcels.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					



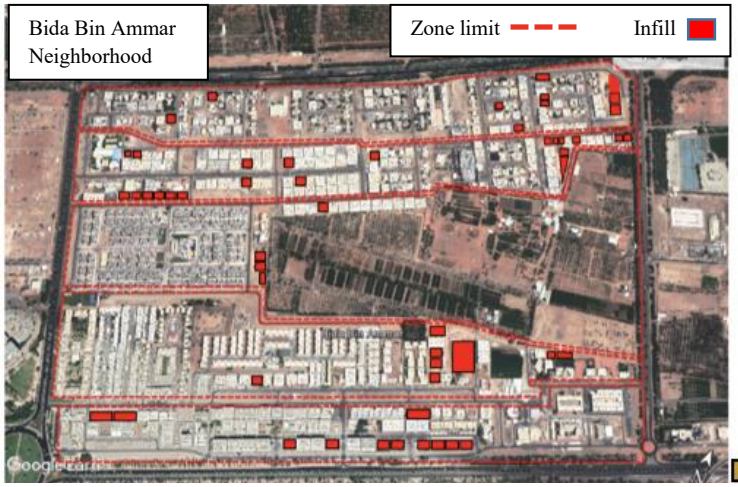
Map 1: Transformation from 2010 to 2019.





Map 2: Bida Bin Ammar Neighborhood in 2019.

Figure 67: (Maps 1, 2) Transformation Towards Infill Development from 2010 to 2019 (Google Earth Maps, 2019).



Map 1: Transformation from 2019 to 2030 (Google Earth Maps, 2019).

Map 2: Bida Bin Ammar Neighborhood in 2030 (Source: AACM).

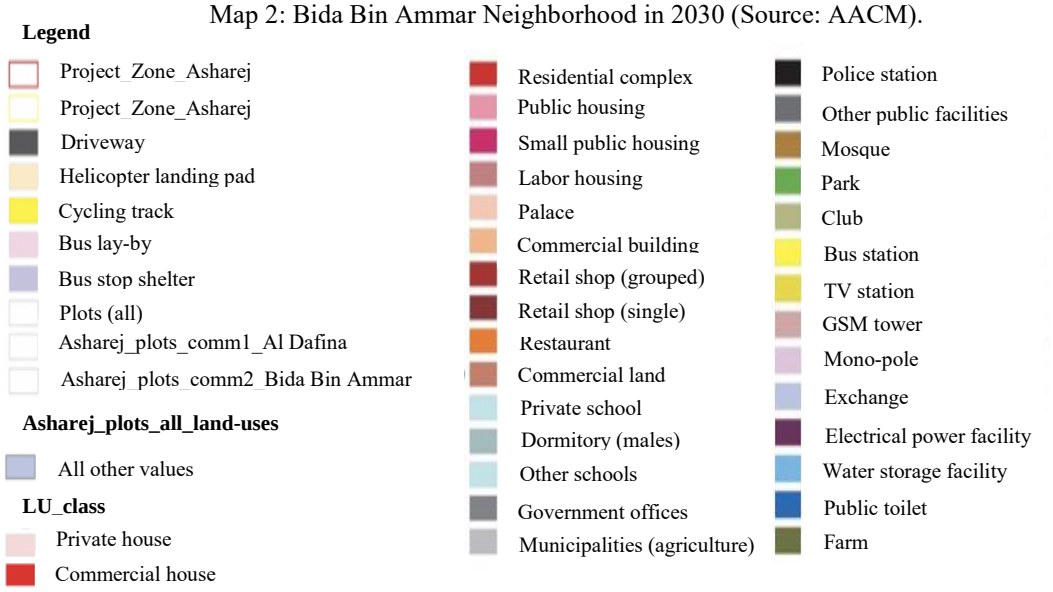
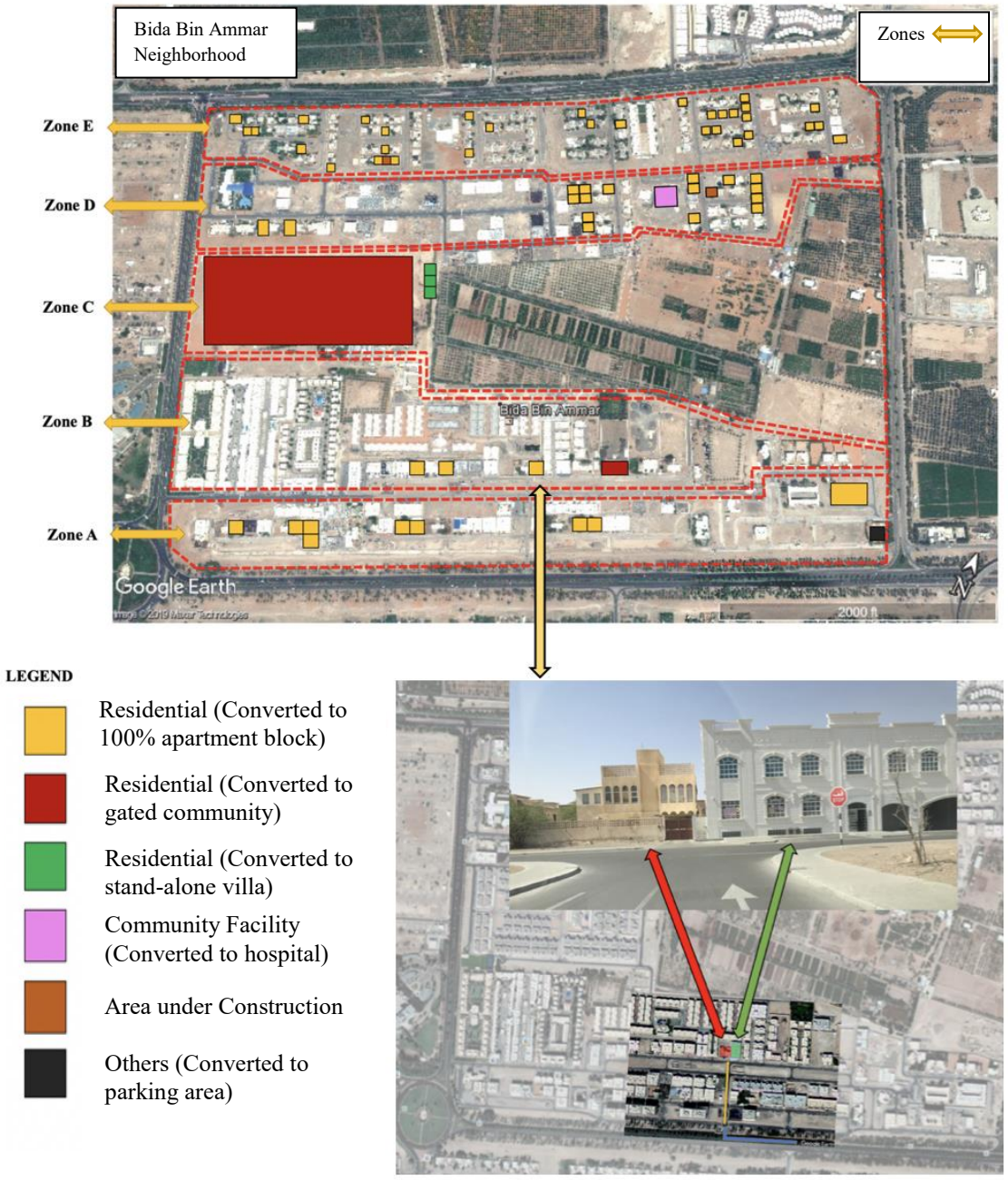


Figure 68: Transformation Towards Infill Development from 2019 to 2030 (Maps 1, 2).

5.2.11 Infill Development: Demolition and Reconstruction

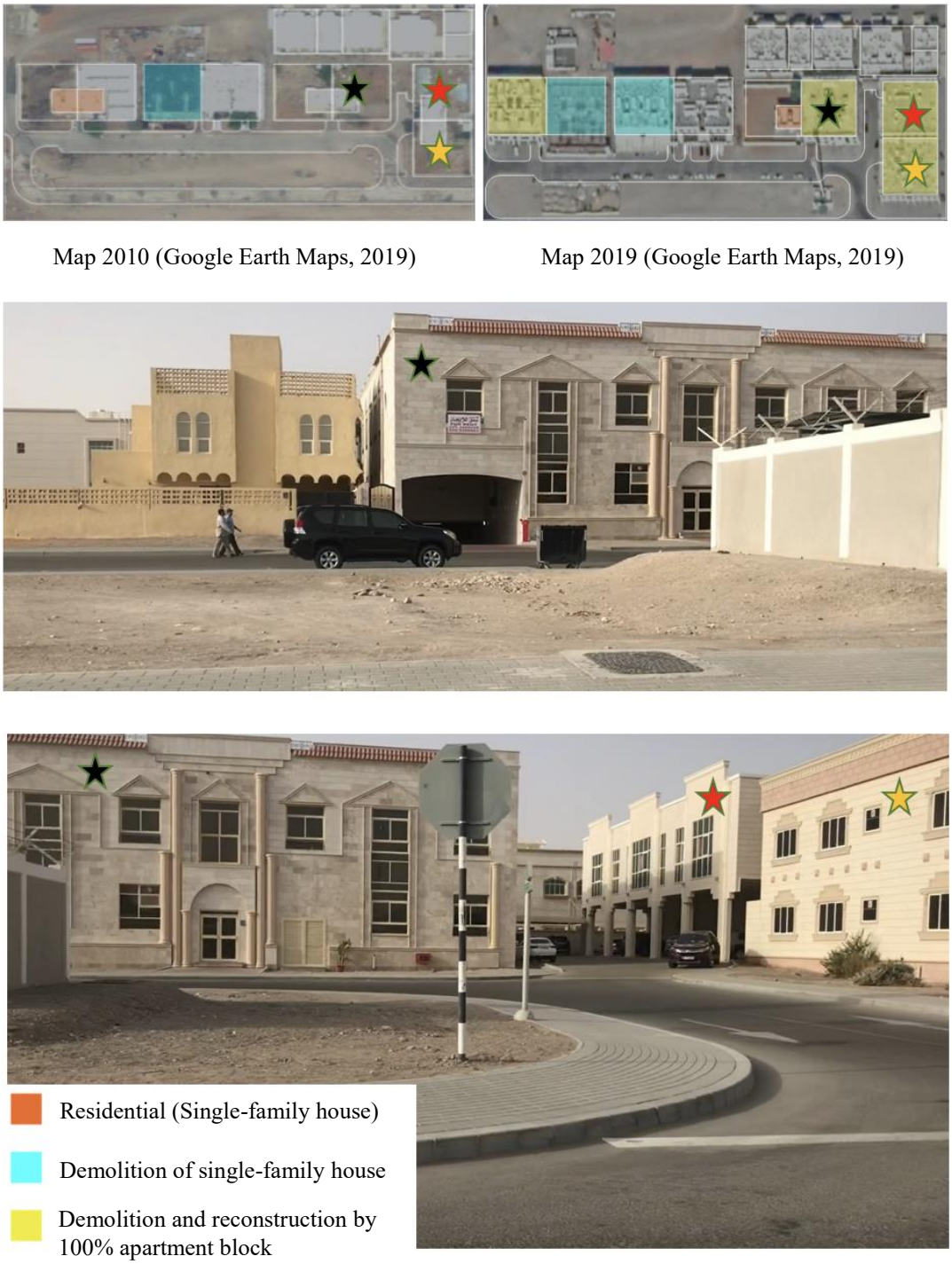
Providing new housing units by demolishing the old existing buildings, and replacing them new ones in order to accommodate a bigger area (bigger mass) is another way of densification that was applied in Bida Bin Ammar in Asharej. The map in Figure 69 shows the locations where demolition happened. In Zone A demolition was applied to an old building, and old single family houses, in order to replace them with one hundred percent apartment blocks. Besides, the demolition method was applied to an unused area. The unused title of land was reutilized to accommodate a parking area. Moreover, in Figure 70 the colored squares in the map of 2010 are indications for single land titles that were utilized for a single family houses. These land titles were demolished and converted to one hundred percent built up area allowing to subdivide the new constructed building into apartments (apartments block). Furthermore, in Zone B demolition was applied to old single family houses, in order to replace them by one hundred percent apartment blocks. See Figures 69, and 72. Also, through the comparison between Google Earth maps in 2010 and 2019 at Zone B, it was realized that there was a transformation from a large single-family house (2010 map) into gated community parcel (2019 map), that provides an additional number of housing units within the same land boundary. Refer to Figure 71. Additionally, in Zone C the demolition took a different way than the other zones. One large area of the farms that are occupying Bida Bin Ammar site is converted to occupy three gated communities' residential housing units (west side of Bida Bin Ammar). On the other hand, a strip of the farm that is located in the middle of Bida Bin Ammar neighborhood was converted to occupy a three stand-alone villas. See Figures 69 and 73 for more clarification. Furthermore, demolition of single family houses and

replacing them new one hundred percent apartment blocks was applied in Zone D. Also, Figure 69 in Zone D shows that there was one old building demolished, and replaced by a community facility (hospital), and one site is still under construction. Check for Figure 74. Additionally, single-family houses were demolished to construct new residential apartment blocks. In addition, in Zone E demolition strategy was applied to the old single family houses that were replaced by one hundred percent apartment blocks. Also, the map of Zone E in Figure 69 displays one title of land that was occupying a single family house is still under construction after the demolition activity. Besides, Figure 75 in Zone E shows the transformation of four land titles from one single family houses into one hundred percent apartment blocks. Also, Figure 75 shows two apartment blocks constructed on a large parcel of land that was vacant, and the other two parcels that are occupied on the same land one of them is still under construction and the other one is still remaining as vacant land. Additionally, in Zone E, four titles of lands were converted from single-family houses into one hundred percent apartment blocks. See Figure 76.



Old stand-alone villa vs 100% built-up area in Bida Bin Ammar neighborhood.

Figure 69: Demolition and Reconstruction Strategy (from 2010 to 2019), in Bida Bin Ammar Neighborhood in Asharej District (Google Earth Maps, 2019).



Map 2010 (Google Earth Maps, 2019)

Map 2019 (Google Earth Maps, 2019)

Figure 70: Infill Development: Demolition and Reconstruction in Zone A – (Map 2010 and Map 2019) - Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

Map 2010

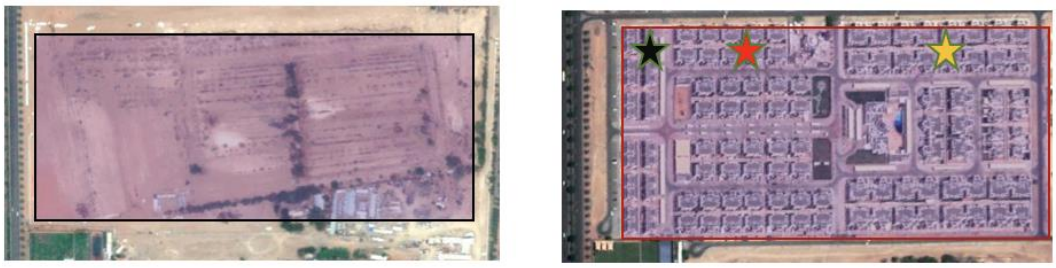
Map 2019

Figure 71: Infill Development: Demolition and Reconstruction in Zone B – (Map 2010 and Map 2019) - Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

Map 2010

Map 2019

Figure 72: Infill Development: Demolition and Reconstruction in Zone B (Single-Family House to 100% Apartments block) – (Map 2010 and Map 2019) - Map Transformation Between 2010 and 2019 (Google Earth Maps, 2019).



Map 2010 Map 2019

Figure 73: Infill Development: Demolition and Reconstruction in Zone C – (Map 2010, and Map 2019) - Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

Map 2010

Map 2019

Figure 74: Infill Development: Demolition and Reconstruction in Zone D – (Map 2010, and Map 2019) - Map Transformation from 2010 to 2019 (Google Earth Maps, 2019).

Figure 75: Infill Development: Demolition and Reconstruction in Zone E – (Map 2010, and Map 2019) - Map Transformation from 2010 to 2019. Location No. 1 (Google Earth Maps, 2019).

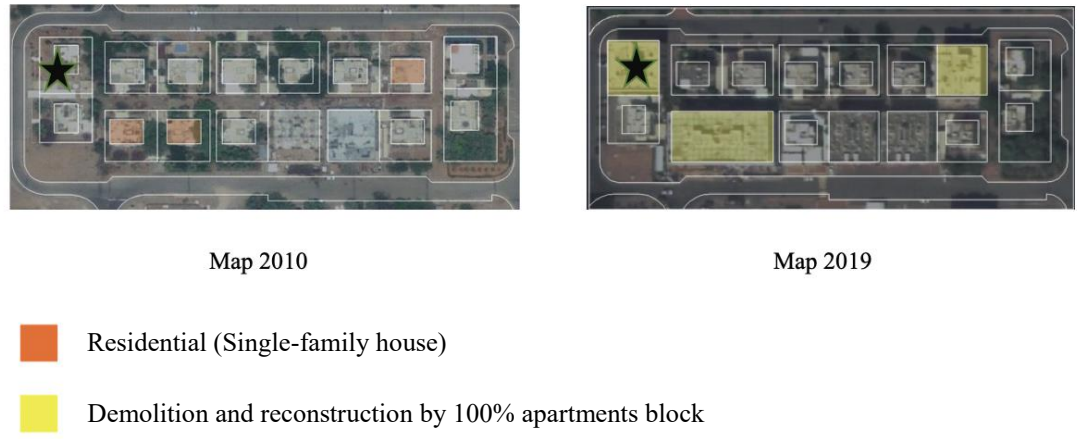


Figure 76: Infill Development: Demolition and Reconstruction in Zone E – (Map 2010, and Map 2019) - Map Transformation from 2010 to 2019. Location No. 2 (Google Earth Maps, 2019).

Through the analysis of google earth maps between 2010 and 2019 in the five zones in Bida Bin Ammar neighborhood, it is realized that providing new housing units by demolishing the old existing buildings, and replacing them by new ones in order to accommodate a bigger area (bigger mass) is significantly applied in Zone E, partially applied in Zone D, and weakly applied in Zones A, B, and C. Refer to Table 20. The infill development tool (through demolition and reconstruction) was assessed

by the Likert Scale, where the value (1) refers to not applied classification, and value (5) refers to fully applied classification. By adding the value (4) that is significantly applied in Zone E, and the value that is indicating for partially applied in Zone D (3), and lastly the three values that are indicating for weakly applied classification in Zones A, B, and C (2+2+2 =6), the result is equal to 13. By subdividing 13 by 5 (5 is the maximum number of the classification application in the five zones as shown in Table 20), the result is 2.6, which is approximately matching with the value assigned to partially applied classification. Therefore, demolition and reconstruction densification tool is partially applied in Bida Bin Ammar neighborhood in Asharej district. Refer to Table 21.

Table 20: Infill Development: Demolition and Reconstruction.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Zone A					
Zone B					
Zone C					
Zone D					
Zone E					

In the end, Table 21 shows the partial application of the development of vacant parcels and demolition and reconstruction. Yet, by adding the two values that are indicating for partially applied for development of vacant parcels and demolition and reconstruction (3+3=6), the result is equal to 6. By dividing 6 by 2, the result is 3, which is matching with the value assigned to partially applied classification. As a result, infill development urban densification tool is partially applied in Bida Bin Ammar neighborhood in Asharej district. See Table 22.

Table 21: Infill Development (Overall Assessment).

	Fully Applied (5)	Significantly Applied (4)	Partially Applied (3)	Weakly Applied (2)	Not Applied (1)
Development of Vacant Parcels.					
Demolition and Reconstruction.					

5.3 Conclusion

Based on the findings that were extracted from the analysis, it is proof that urban densification has been a prominent method in the study area since 2010. The chapter analyzed the tools on which urban densification has taken place between 2010 and 2019 in Bida Bin Ammar neighborhood in Asharej district, for each specific zone out of the five zones in the study (Zones: A, B, C, D, and E). Moreover, qualitative assessment (field observations and maps analysis) is linked to the Likert scale to analyze the tools of urban densification. The author used the numbers of the Likert scale just for the ease of explanation rather than trying to quantify qualitative data. Also, the author relied on descriptive explanation in the analysis of the applied urban densification tools in the study area. In conclusion, as shown in Table 22, mixed-use and intensification are weakly applied in the study area, where mixed housing and infill development are partially applied in the Bida Bin Ammar neighborhood in Asharej district.

Table 22: Summary of Urban Densification Tools.

	Fully Applied (5)	**Significantly Applied (4)**	**Partially Applied (3)**	**Weakly Applied (2)**	**Not Applied (1)**
Mixed-Use.					
Horizontal Mixed-Use.					
Vertical Mixed-Use.					
Mixed-Use Walkable Areas.					
Mixed Housing.					
Mixed Tenure.					
Mixed Types.					
Intensification.					
Subdivision of Property.					
Consolidation.					
Vertical Extension.					
Horizontal Extension.					
Increase of Bulk Rights.					
Attached/ Detached Second Dwelling.					
Infill Development.					
Development of Vacant Parcels.					
Demolition and Reconstruction.					

Chapter 6: Analysis of the Impact of the Applied Urban Densification Tools on Social Sustainability in Bida Bin Ammar Neighborhood in Asharej District

6.1 Introduction

This chapter identifies the impacts of the applied urban densification tools in which have taken place in quo status in the Bida Bin Ammar neighborhood in Asharej district on social sustainability principles. Several social sustainability principles can be affected by urban densification such as density, accessibility, mobility, mixed-use, social capital, quality of life, sense of belonging, safety, and security, and community participation. These principles are analyzed according to the conceptual framework of social sustainability principles and indicators. Refer to Table 2 in Appendix A. Each principle is measured through its indicators by using different tools such as field observation, land use map, Google Earth maps, and analysis of CAD drawings. Moreover, the author provides the findings for each of the studied principle of social sustainability. The following chapter provides an interpretation of the data analyzed in Chapters 5, and 6.

6.2 Impacts of Urban Densification on Social Sustainability Principles in Bida Bin Ammar Neighborhood

6.2.1 Density

Indicator 1: Gross Density

According to Al Ain region 2030 demographic forecasts (Table 34 in Appendix B - source: AACM), the total population in 2010 for both Emirati and foreign people in Bida Bin Ammar neighborhood in Asharej district was 2973, where the expected

total population in 2030 will be 4797. Moreover, the area of Bida Bin Ammar neighborhood in Asharej district is 211.3 hectare. Since, the gross density is equal to the total population divided by the total area, we conclude that the gross density of Bida Bin Ammar neighborhood in 2010 is equal to 2973/ 211.3 = 14.07 persons per hectare, which is classified as low density, as per Barton who mentioned that a gross population density at which travel distance is lowest should range between 40 to 50 (Barton, 2000). In 2030 the gross density is equal to the total expected population divided by the total area of Bida Bin Ammar neighborhood which is equal to 4797/ 211.3 = 22.70 persons per hectare. Since the calculated gross density for the year of 2010, and the calculated gross density for the expected population in 2030 were below 40 to 50 person per hectare, the density in Bida Bin Ammar neighborhood is considered as low-density neighborhood. Therefore, density is weakly achieved in Bida Bin Ammar neighborhood in Asharej district. See Table 23.

Table 23: Density Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Gross Density.					

6.2.2 Mixed-Use

Indicator 1: Provision of Various Facilities and Amenities with Different Activities According to the Different Local Needs

Through the analysis that was done in Chapter 5, Bida Bin Ammar neighborhood in Asharej district contains a mixture of various community facilities

such as commercial, residential, mixed-use blocks, and community facilities (masjid, retail, restaurant, school, nursery, hospital, medical clinics, health club, and police station). Refer to the land use map in Figure 33 Chapter 5 for more details. Most of the community facilities such as retails, restaurants, cafes, and banks are concentrated in the mixed-use blocks that are only available in Zone A. See Figure 34 in Chapter 5. Thus, mixed-use through provision of various facilities, and amenities with different activities according to the different local needs is partially achieved in Bida Bin Ammar neighborhood.

Indicator 2: Availability of Job Opportunities

By analyzing the land use map of Bida Bin Ammar (See Figure 33 in Chapter 5), it can be realized that job opportunities are distributed in accordance to the various community facilities such as (retail, restaurant, school, nursery, hospital, medical clinics, health club, and police station). Also, Figure 34 in Chapter 5 showed that most of the community facilities such as retails, restaurants, cafes, and banks are concentrated in the mixed-use blocks that are only available in Zone A. Therefore, availability of job opportunities to be accessible, and available to be called on in Bida Bin Ammar is partially achieved in Bida Bin Ammar neighborhood.

Indicator 3: The Presence of Various Housing Types

As studied previously in Chapter 5, mixed housing types is significantly achieved in Bida Bin Ammar neighborhood. Finally, Table 24 demonstrates that the provision of various facilities and amenities with different activities according to the different local needs, as well as the availability of job opportunities to be accessible, are partially achieved, where the presence of various housing types is significantly

achieved. Yet by adding the two values that are indicating to partially achieved classification for Indicators 1 and 2, and the value that is indicating to significantly achieved classification, the result is equal to (3+3+4=10). By dividing 10 by 3, the result is equal to 3.33, which is approximately matching with the value assigned to partially achieved classification. Thus, mixed-use is partially achieved in Bida Bin Ammar neighborhood. Refer to Table 32.

Table 24: Mixed-Use Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Provision of various facilities, and amenities with different activities according to the different local needs.					
Ind.2: Availability of job opportunities.					
Ind.3: The presence of various housing types.					

6.2.3 Accessibility

Indicator 1: Provision of Local Facilities and Job Opportunities

Through the analysis that was clarified in the previous Section (6.2.2 mixed-use), the provision of local facilities, and job opportunities to be accessible in Bida Bin Ammar neighborhood is partially achieved in Bida Bin Ammar neighborhood.

Indicator 2: Local Catchment Distance and Good Pedestrian Accessibility to Local Services

According to (Barton, 2000), 80% of the houses in a certain neighborhood should achieve the catchment distance standards through easy access to the destination. So, to measure the local catchment distance, and good pedestrian accessibility to local services (5 or 10 minutes by walking or cycling within distance of 400-800 m, instead of using cars), analysis of CAD drawings is done to measure the catchment distance for the nearest daily use of local services and facilities in Bida Bin Ammar neighborhood such as retail, school, nursery, medical clinic, hospital, farm, health club, and masjid. The average distance to allow for easy access to local shops (retail) as per catchment distance standards that were indicated by (Barton, 2000) is 400-800 m. Figure 77 demonstrates the map analysis of the catchment distance in Bida Bin Ammar neighborhood. Through the analysis of CAD, it is realized that they are located at the south of Bida Bin Ammar neighborhood, and cover 46.7% of the neighborhood. In addition, the catchment distance of medical clinics is 800-1000 m, and 5000 m for the hospital. By analyzing the CAD drawing, it is recognized that medical clinics are located at the north of Bida Bin Ammar neighborhood, and cover most of the neighborhood. Besides, “Medeor” hospital serves the whole neighborhood. Refer to Figure 78. Furthermore, the catchment distance for the school is 400-600 m, and for the nursery is 200-300 m. Also, from the analysis of CAD drawing, it is noticed that school and nursery are located northwest of Bida Bin Ammar neighborhood, and cover 27.4% of the development. See Figure 79. Moreover, the catchment distance to allow for easy access to masjids as shown in Figure 80 is 400-800 m. Besides, by studying the CAD drawing, it is explored that masjids were distributed in various locations in Bida Bin Ammar neighborhood, and serve the whole neighborhood. Additionally,

Figure 81 displays that the catchment distance for easy access to play field (club) is 800-1000 m. As well, through the analysis of CAD drawing, it is realized that play field (club) is located north of Bida Bin Ammar neighborhood, and in most of the neighborhood. Finally, the catchment distance to access major natural space (farms) easily is 2000-5000 m. Thus, by analyzing the CAD drawing, it is noticed that major natural space (farms) is located north of Bida Bin Ammar neighborhood, and cover the whole neighborhood. Refer to Figure 82.

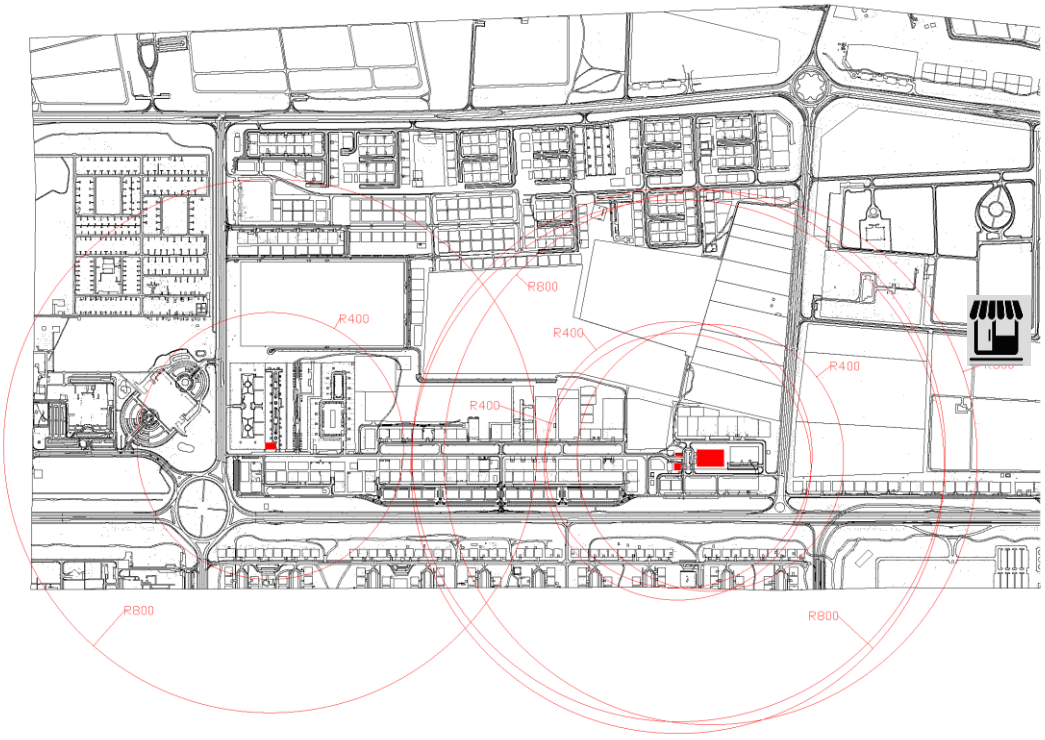


Figure 77: Average Distance to Nearest Daily Use: Local Shops (Retails) 400-800 m.

Figure 78: Local Catchment Distance for Clinics and Health Centers 800-1000 m.

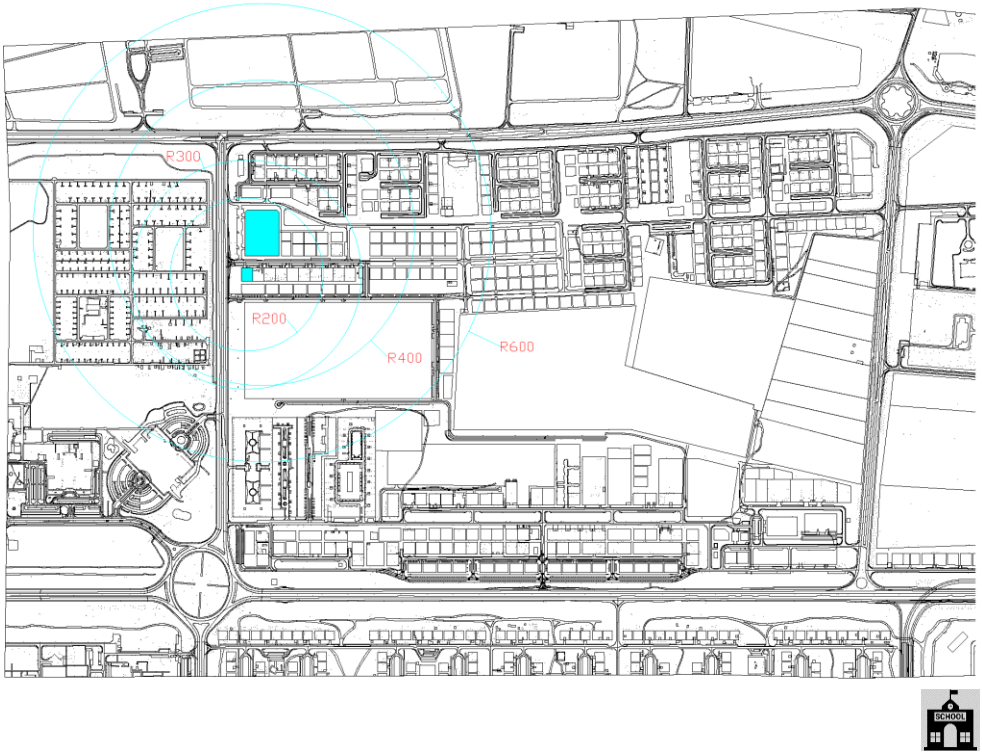


Figure 79: Local Catchment Distance to School 400-600 m, and Nursery 200-300 m.

Figure 80: Local Catchment Distance to Masjids 400-800 m.

Figure 81: Local Catchment Distance to Play Field (Club) 800-1000 m.

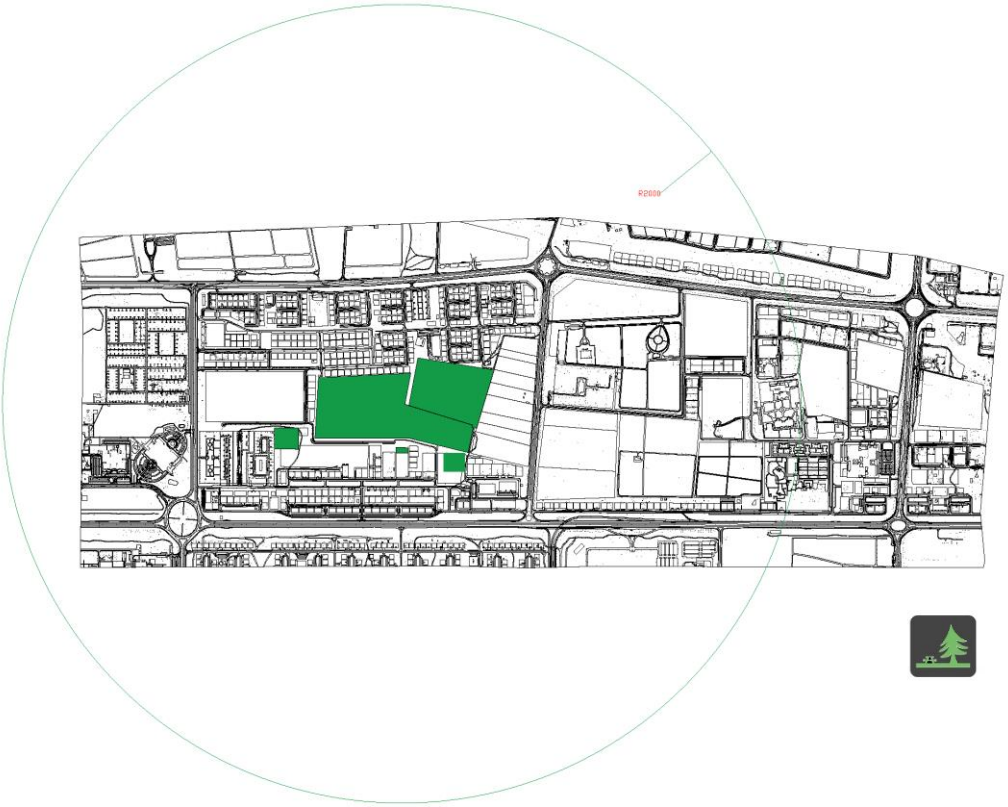


Figure 82: Local Catchment Distance to Major Natural Space (Farms) 2000-5000 m.

In the end, accessibility through the catchment distance for the nearest daily use of local services and facilities in Bida Bin Ammar neighborhood such as retail, school, nursery, medical clinic, hospital, farm, health club, and masjid, is significantly achieved.

Indicator 3: The Presence of Public Transportation within Average Walkable Distance to the Nearest Bus Stop (300 – 400 m)

The presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m) is not achieved in Bida Bin Ammar neighborhood. Refer to Section 6.2.4 – Mobility: Public Transportation - Indicator 2- for more clarification.

Finally, Table 25 displays that accessibility through the provision of various facilities, and job opportunities is partially achieved, and accessibility through the catchment distance for the nearest daily use of local services and facilities, and the presence of public transportation within average walkable distance to the nearest bus stop is significantly achieved, where accessibility through the presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m) is not achieved in Bida Bin Ammar neighborhood. By adding the value that is indicating to partially achieved classification for Indicator 1, the value that is indicating to significantly achieved classification for Indicator 2, and the value that is indicating to not achieve classification for Indicator 3, the result is equal to (3+4+1=8). Yet by dividing 8 by 3, the result is equal to 2.67, which is approximately matching with the value assigned to partially achieved classification. Thus, accessibility is partially achieved in Bida Bin Ammar neighborhood. See Table 32.

Table 25: Accessibility Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Provision of local facilities, and job opportunities.					
Ind.2: Local catchment distance, and good pedestrian accessibility to local services.					
Ind.3: The presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m).					

6.2.4 Mobility

Walkability and Bikability (Indicator 1: Provision of Safe Pedestrian Walkways and Safe Cycling Routes)

From the field observation, it is noticed that there is a dominant reliance on car use in the neighborhood without proper provision of pedestrian walkways, footpaths, and cycling routes to be safe, shaded, pleasant, and well maintained. Also, there is no shared lanes for cycling with private cars. Moreover, Bida Bin Ammar neighborhood lacks attractive and safe sidewalks. Besides, wall fences of the single family houses are high, so they are blocking the natural surveillance. Figure 83 in Zone A shows that the restaurant which, is located in a mixed-use building, blocked the pedestrian walkway by putting its seating area outside the shop. Also, the sidewalk is not safe because the motorcycles are parking next to the restaurants and cafeterias. Besides, in Zone B, the cafe is blocking the sidewalk because of the outside setting area, which functions as an obstacle that limits the pedestrian from walking smoothly and safely. Also, Figure 84 (a) in Zone E shows that the green fence of the single-family house, which is used for privacy purposes (to hide the tent which is used as outside majlis from the neighbors), is blocking the pedestrian movement. Besides, Figure 84 (b) displays that the car is parking on the kerbstone and hampers the pedestrian from walking. Moreover, wall fences of the residential villas (Figure 85 - a), and the wall fences of the farm (Figure 85 - b) in Zone B are high, so they are blocking the natural surveillance. In addition, Figure 86 clarifies that there is no provision of cycle routs, and sidewalks are not well maintained for pedestrian to walk safely. Furthermore, in Zone E in (Figure 87 a, b) sikkahas (pedestrian passages) are not well maintained for pedestrians to walk safely. In (Figure 87 - a) the parked car blocks the pedestrian

movement, where in (Figure 87 - b), the undeveloped sandy area beside the house blocks the pedestrian movement.

a) b)

Figure 83: Outside Sitting Areas Work as Obstacles in the Pedestrian Walkways (a, b).

a) b)

Figure 84: Outside Fence Work as Obstacles in the Pedestrian Walkway (a). Car Blocks the Movement in the Pedestrian Walkway (b).

a) b)

Figure 85: Wall Fences Block the Natural Surveillance in the Pedestrian Walkways (a, b).

a) b)

Figure 86: Sidewalks are not Well-Maintained for Pedestrian to Walk Safely, and there is No Provision of Cycle Routs. a) Zone E. b) Zone B.

a) b)

Figure 87: Parked Car Blocks the Pedestrian Movement (a). The Undeveloped Sandy Area Beside the House Blocks the Pedestrian Movement (b).

Therefore, from the analysis of the field observations in Bida Bin Ammar neighborhood in Asharej district, it is explored that the provision of safe pedestrian walkways (surveillance) and cycling routs is not achieved in Bid Bin Ammar neighborhood. See Table 26. However, refer to Figure 105 in Appendix B for the pedestrian and cycling plan in Plan Al Ain 2030.

Public Transportation (Indicator 2: The Presence of Public Transportation within Average Walkable Distance to the Nearest Bus Stop 300 – 400 m)

Al Ain City Bus Service Network Map shows that the nearest bus stop to Bida Bin Ammar neighborhood in Asharej district is more than 2000 m (North West), and more than 4000 m (west) from the center of Bida Bin Ammar neighborhood. See Figure 88.

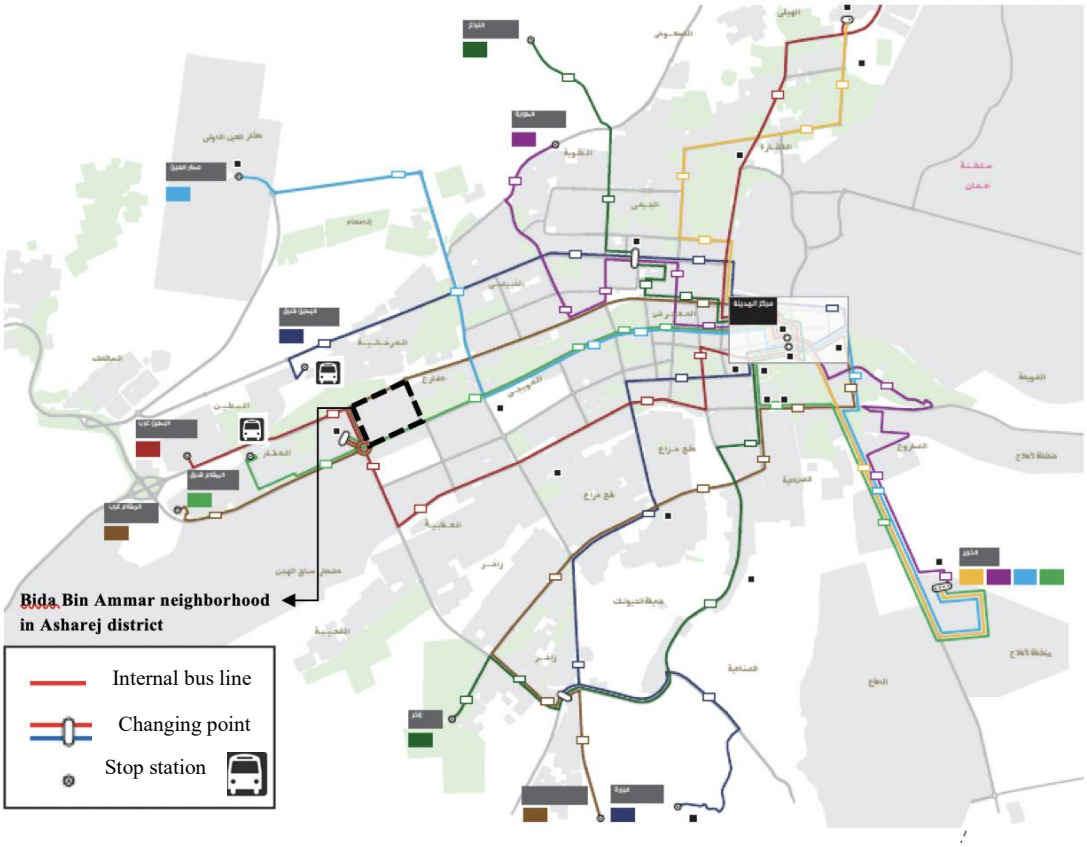


Figure 88: Al Ain City Bus Service Network Map. (Al Ain City bus service network map, 2020).

Therefore, the availability of bus stops within a walkable distance (300-400 m) is not achieved in Bida Bin Ammar neighborhood. Refer to Table 26. However, Plan Al Ain 2030 contains the transport framework that is going to be implemented in Al Ain by 2030 according to Al Ain 2030 vision. See Figure 104 in Appendix B.

Indicator 3: Availability of Transportation Nodes

There is a lack of transportation nodes in the development, and there is no provision of efficient public transport systems and services. Thus, availability of transportation nodes is not achieved in Bida Bin Ammar neighborhood. See Table 26.

Indicator 4: Provision of Fast Efficient Public Transport (Mass Rail Transit System, Transport Technologies, Motorways, Trams, and Train Services)

From the field observation in Bida Bin Ammar neighborhood, there is no provision of fast efficient public transport (mass rail transit system, transport technologies, motorways, trams, and train services). Therefore, the Provision of fast efficient public transport in Bida Bin Ammar neighborhood is not achieved. Refer to Table 26. However, refer to Figure 104 in Appendix B for Al Ain Plan 2030 transportation framework (transit).

Indicator 5: Provision of Roads, Bus Routes, Bus Stops, Network of Streets and Squares

As explained previously in Chapter 5 Section 5.2.1, Bida Bin Ammar neighborhood is adjacent to Shakhboot bin Sultan Street from the north, and to Khalifa Bin Zayed Street from the south. Moreover, from the analysis of CAD drawing of Bida Bin Ammar neighborhood, it is realized that street network is organized to have roads and sub roads with less width (local streets) internally between plots to reduce the cars' speed and to be safer for the pedestrian while crossing the streets. See Figure 89. However, refer to Figure 103 in Appendix B for Al Ain Plan 2030 transportation framework (roads classification types).

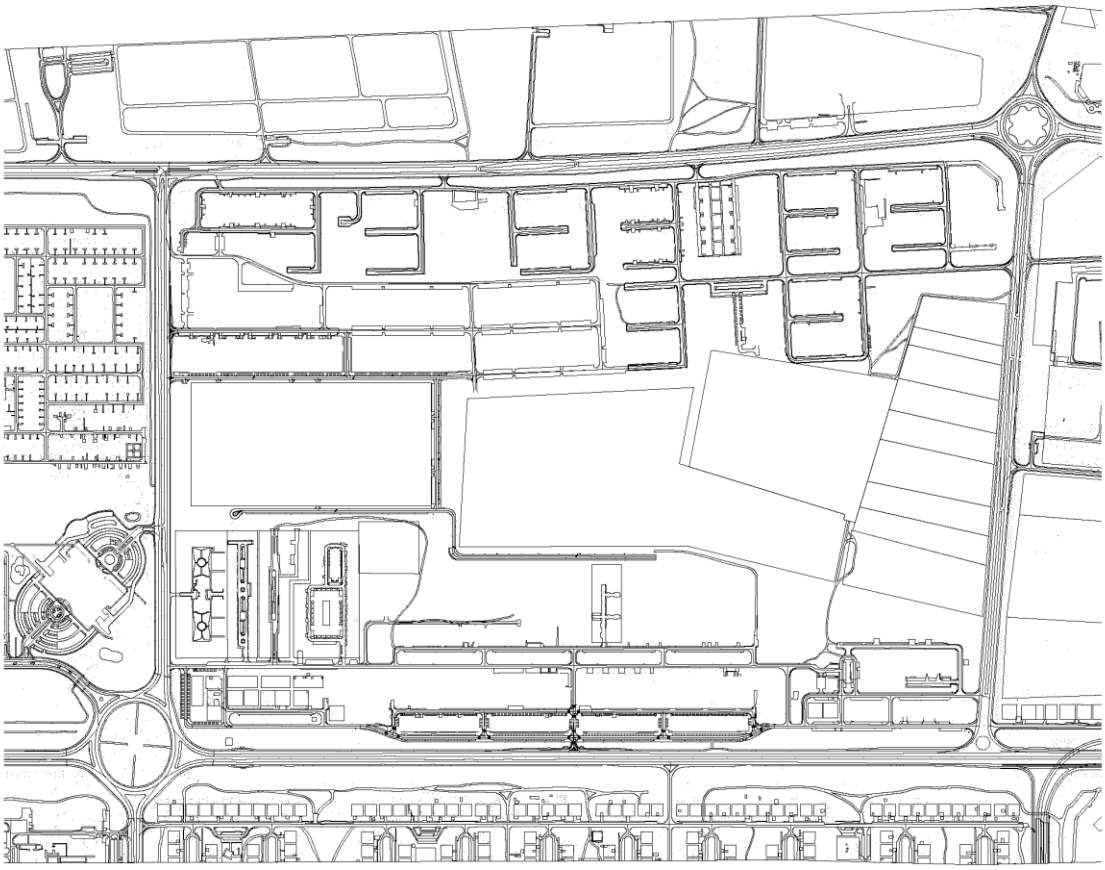


Figure 89: Streets Network in Bida Bin Ammar Neighborhood.

However, there is no convenient affordable bus routes, and bus stops in the neighborhood. Thus, mobility (public transportation) through the provision of roads, streets and squares, bus routes, and bus stops is weakly achieved in Bida Bin Ammar neighborhood. See Table 26.

Private Cars (Indicator 6: Less Permeability Use of Cars (Car Restraint, and Street Calming, Giving Priority to the Design of High Amenity Footpaths and Cycle Ways, and Emphasizing Pedestrian Comfort and Constraining Cars)

Less permeability use of cars can be achieved by car restraint, and street calming, through emphasizing pedestrian comfort and constraining cars (Barton, 2000). From the field observation, it is realized that street calming in Zone A includes the provision of car bumps that help reducing cars' speed and giving priority to the pedestrian to cross the streets safely, while there is a lack in the provision of car bumps in the other four zones in Bida Bin Ammar neighborhood. See Figures 90, 91 and 92. In addition, Figures 90, and 91 display the provision of pedestrian crossing signs, car bumps signs, column posts obstacles (not to allow cars to park above the kerb in the pedestrian walkways), and footpaths. Moreover, it is dominant to see at the rest of the neighborhood (Zones B, C, D, and E), the provision of street turns to reduce cars' speed (refer to Figures 89 and 92 for more clarification). Furthermore, there is a lack in the provision of speed limit signs, signals, and roundabouts, to reduce cars' speed throughout the neighborhood. Thus, mobility (private cars) through the allowance of less permeability use of cars (car restraint, and street calming, and emphasizing pedestrian comfort and constraining cars) is partially achieved in Bida Bin Ammar neighborhood. See Table 26.

Figure 90: Car Restraint and Street Calming in Zone A (a, b, c, d, e, f) in Bida Bin Ammar Neighborhood.

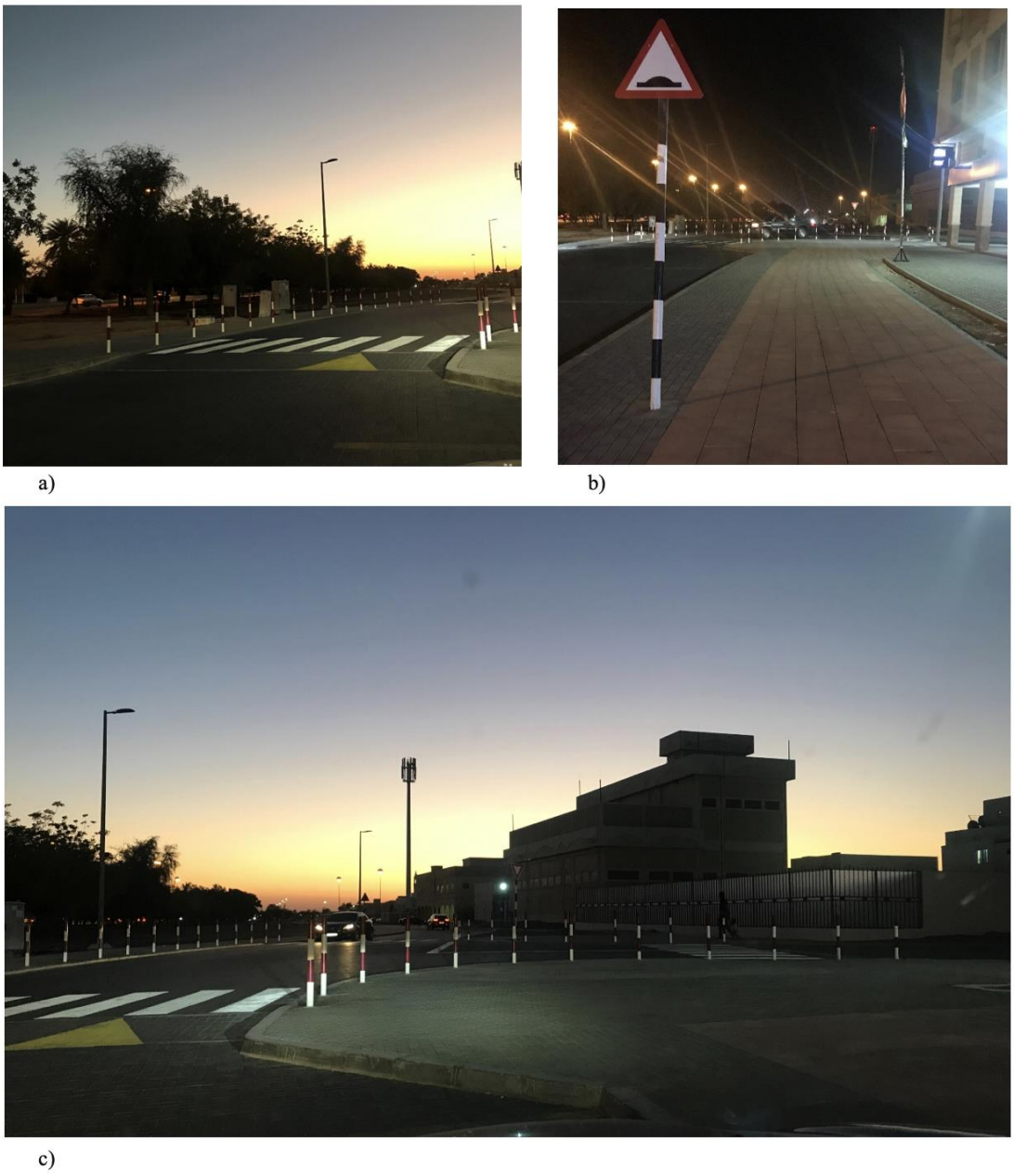


Figure 91: Car Restraint and Street Calming (a, b, c) in Zone A in Bida Bin Ammar Neighborhood.

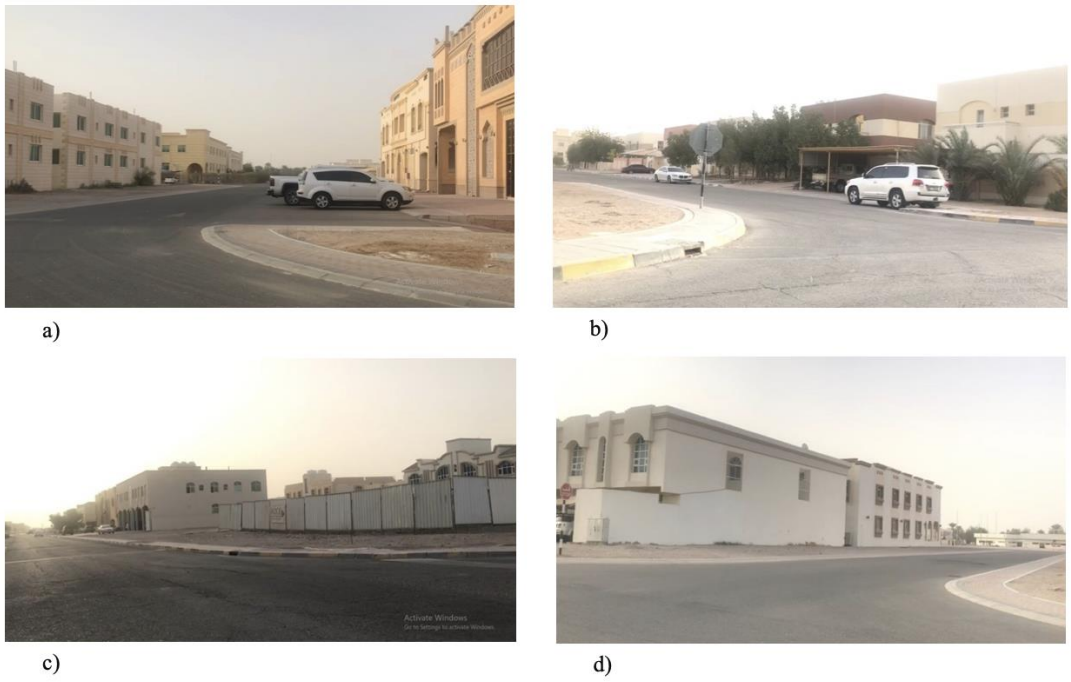


Figure 92: Street Calming Through the Provision of Street Turns to Reduce Cars' Speed in Various Zones (a, b, c, d) in Bida Bin Ammar Neighborhood.

Finally, Table 26 demonstrates that Indicators 1, 2, 3, and 4, are not achieved, and Indicator 5 is weakly achieved, where Indicator 6 is partially achieved. Yet by adding the four values that are indicating to not achieve classification for Indicators 1, 2, 3 and 4, the value that is indicating to weakly achieved classification (2), and the value that is indicating to partially achieved classification (3), the result is equal to (1+1+1+1+2+3=9). By dividing 9 by 6, the result is equal to 1.5, which is approximately matching with the value assigned to weakly achieved classification. Thus, mobility is weakly achieved in Bida Bin Ammar neighborhood. Refer to Table 32.

Table 26: Mobility Assessment.

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Ind.1: Provision of safe pedestrian walkways and safe cycling routes.					
Ind.2: The presence of public transportation within average walkable distance to the nearest bus stop.					
Ind.3: Availability of transportation nodes.					
Ind.4: Provision of fast efficient public transport.					
Ind.5: Provision of roads, bus routes, bus stops, network of streets and squares.					
Ind.6: Less permeability use of cars.					

6.2.5 Social Capital

Indicator 1: Provision of Various Facilities, and Amenities with Different Activities According to the Different Local Needs

Provision of various facilities, and amenities with different activities according to the different local needs is partially achieved in Bida Bin Ammar neighborhood. Refer to Section 6.2.2 Mixed-Use – Indicator 1.

Indicator 2: Availability of Job Opportunities

Availability of job opportunities, and skills (full range of common trades and skills to be accessible, and available to be called on) is partially achieved in Bida Bin Ammar neighborhood. (Refer to Section 6.2.2 Mixed-Use – Indicator 2).

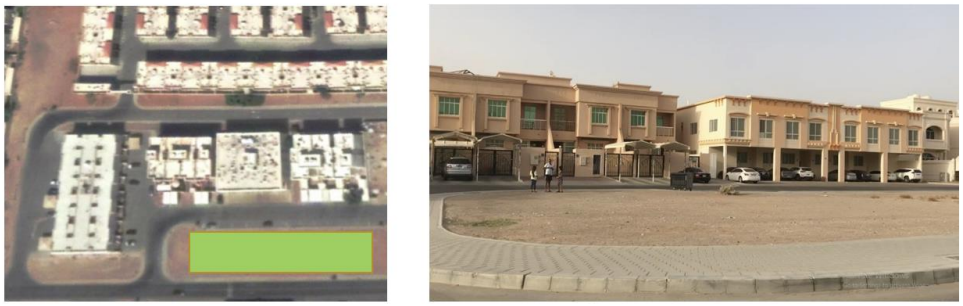
Indicator 3: Participation in Community and Social Activities (Neighborhood Relationship: Knowing and Frequency of Meeting their Neighbors)

From the field observation, it is noticed that there is a lack of day to day lifestyle activities due to the lack of providing a range of open spaces to cater to the need of the multicultural community such as ceremonial spaces, public art, kids play areas, open lawn areas for informal play, urban spaces and plazas, public realm (community park, family park, sikkas, and barahas). Figure 92 shows two different locations in Bida Bin Ammar neighborhood that need to be developed to serve the neighborhood and to allow people to use for gathering from time to time. As mentioned by Yoo and Lee (2016), social sustainability, social capital, and the neighborhood built environment are logically connected. Social capital exists through interactions and in networks among people. Thus, it is related to physical factors, and therefore, space for interaction is needed, and this indicates the significance of the environment in the process of developing social capital in the neighborhood. Besides, the participation in community and social activities is related to the creation of activity hubs places to create a sense of urban vitality in the community (Barton, 2000). Based on the field observations and the analysis of the land-use map of Asharej district, there is a lack of day to day lifestyle activities that allow people to interact and participate in the community and social activities. Therefore, social capital (social interaction) by the participation in community and social activities is not achieved in Bida Bin Ammar

neighborhood. However, Table 27 shows that the provision of local facilities, and availability of job opportunities, and skills are partially achieved, where participation in community and social activities is not achieved in Bida Bin Ammar neighborhood. By adding the two values that are indicating to partially achieved classification for Indicators 2 and 3, and the value that is indicating to not achieve classification, the result is equal to (3+3+1=7). By dividing 7 by 3, the result is equal to 2.33, which is approximately matching with the value assigned to weakly achieved classification. Thus, social capital is weakly achieved in Bida Bin Ammar neighborhood. See Table 32.

Table 27: Social Capital Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Provision of local facilities.					
Ind.2: Availability of job opportunities.					
Ind.3: Participation in community and social activities.					



a) Undeveloped land in residential area in Zone A.

b) Undeveloped land in sports field area in Zone E.

Figure 93: Undeveloped Lands in Various Zones (a, b) in Bida Bin Ammar Neighborhood.

6.2.6 Quality of Life

Suitable Living Areas and Spaces (Indicator 1: Attraction of the Places for Living, Working, Shopping, and Enjoyment of the Leisure Time, and Greater Access to Open Space)

Suitability of living areas and spaces is correlated with the attraction of the place for living and working. Thus, attraction of the place to be suitable for living, working, and shopping can be achieved through provision of various facilities, and amenities with different activities according to the different local needs (mixed-use), and through the availability of job opportunities to be accessible, and available to be called on (as studied previously in Section 6.2.2). Moreover, Bida Bin Ammar neighborhood is surrounded by various educational and health facilities that can create various employment opportunities, and thus attract the people to live and work in the

neighborhood. Bida Bin Ammar neighborhood in Asharej district is near to Abu Dhabi University in Al Dafinah neighborhood from the east, and to United Arab Emirates University in Shabhanet Asharej from the south. Also, it is near from Tawam hospital in the west. All these educational and health facilities are within Asharej district, which makes the area more attractive for the people to live and work. However, based on the field observations and the analysis of the land-use map of Asharej district, there is a lack in the provision of open spaces, public realms, and leisure places for enjoyment, which can be the main attraction of a new destination for the Bida Bin Ammar neighborhood in terms of high-quality lifestyle. Figure 93, shows that undeveloped sandy areas are prevailed in different areas in Bida Bin Ammar neighborhood. Though, quality of life (suitable living areas and spaces) through attraction of the places for living, working, shopping, and enjoyment of the leisure time, and greater access to open space is partially achieved in Bida Bin Ammar neighborhood.

Quality of Life: Health (Indicator 2: Provision of Fast Efficient Public Transport)

Provision of fast efficient public transport, various transport technologies, and motorways (mass rail transit system, transport technologies, motorways, trams, and train services), to encourage the friendly ways of moving (walking and cycling to reduce pollution from the car) is not achieved in Bida Bin Ammar neighborhood. See Section 6.2.4 - Mobility: Public Transportation.

Indicator 3: Less Permeability Use of Cars (Car Restraint, and Street Calming, Giving Priority to the Design of High Amenity Footpaths and Cycle Ways, and Emphasizing Pedestrian Comfort and Constraining Cars)

Quality of life (health) is associated with the less permeability use of cars, and the human powered movement (friendly ways of moving: walking and cycling to

reduce pollution from car), which is partially achieved in Bida Bin Ammar neighborhood. Refer to Section 6.2.4 - Mobility: Private cars.

Indicator 4: The Presence of Locally-Based Energy Supply Systems, and Waste Recycling Systems (Local Recycling of Organic Waste and Refuse), Use of Local Materials, Enhancement of Local Habitat Diversity, and Preservation of Green Land

Through the field observation in Bida Bin Ammar neighborhood, it is realized that there is an absence of locally-based energy supply systems, and waste recycling systems (local recycling of organic waste and refuse). In addition, there is a lack in the provision of green spaces and public realms. Thus, the enhancement of local habitat diversity is limited in the neighborhood. However, some private farms have been preserved in Bida Bin Ammar neighborhood (see Figure 82 in Section 6.2.3 – Accessibility). Moreover, local materials such as sand and cement are used for construction in the neighborhood. Therefore, quality of life through Indicator 14 is weakly achieved in Bida Bin Ammar neighborhood.

Indicator 5: Improvement of Air Quality, Food Quality (Local Production of Food), and Heathy Lifestyles (Consumption of Fresh Fruit, and Vegetables from Local Gardens, and City Farms)

From the field observation of Bida Bin Ammar neighborhood, it was noticed that there is no provision of fast efficient public transport, and a lack in the provision of safely and friendly pedestrian and cycling ways of movement. Also, there is a dominate use of car in the neighborhood, which adversely effect the quality of quality of life (health), and air by the CO_2 emissions. Besides, there is neither local food production nor consumption of fresh fruit, and vegetables from local gardens, and city farms in the neighborhood. Thus, healthy lifestyles through Indicator 15 is not achieved in Bida Bin Ammar neighborhood. Table 6 displays the results of the

indicators related to the quality of life (suitable living areas and health). So, by adding the two values that are indicating to partially achieved classification for Indicators 11 and 13, and the value that is indicating to weakly achieved classification for Indicator 14, and the two values that are indicating to not achieved classification for Indicators 9 and 15, the result is equal to (3+3+2+1+1=10). By dividing 10 by 5, the result is equal to 2, which is matching with the value assigned to weakly achieved classification. Thus, quality of life is weakly achieved in Bida Bin Ammar neighborhood. Refer to Table 32.

Table 28: Quality of Life Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Attraction of the places for living, working, shopping, and enjoyment of the leisure time, and greater access to open space. (Suitable Living Areas and Spaces).					
Ind.2: Provision of fast efficient public transport. (Health).					
Ind.3: Less permeability use of cars. (Health).					

Table 28: Quality of Life Assessment (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Ind. 4: The presence of locally-based energy supply systems, and waste recycling systems. (Health).					
Ind. 5: Improvement of air quality, food quality (local production of food), and heathy lifestyles (consumption of fresh fruit, and vegetables from local gardens, and city farms). (Health).					

6.2.7 Sense of Belonging

Indicator 1: Personalization (Image) of Neighborhood Depending on what People Feel is Home Terrain, and Identified by Landmarks (Pride of Place/ Place Attachment), and the Presence of Distinctive Public Spaces, Higher Buildings, and Public Art, which Residents and Visitors Can Find their Way Around, and Can Experience the Place on Foot. (Local Distinctive, and Heritage: Sounds, and Smells of the History of the Place)

As mentioned previously in Section 6.2.5 Social Capital (social interaction) - Indicator 12 - There is a lack in the provision of open spaces (public arts and plazas) in Bida Bin Ammar neighborhood. Also, as noticed from the field study, there is a lack in the presence of distinctive public spaces, and higher buildings, which residents and visitors can find their way easily around, and can experience the place on foot. Moreover, there is no local distinctive and heritage place in Bida Bin Ammar neighborhood that reflects the sounds, and smells of the history of the place. The old

style of the single-family houses with the narrow design of the windows is not preserved. Such single-family houses are going under demolition and replacement with different types of designs. See Figure 69 in Chapter 5. Therefore, personalization (image) of Bida Bin Ammar neighborhood depending on what people feel is home terrain, and identified by landmarks (pride of place/ place attachment) is not achieved.

Indicator 2: Responsiveness to Local Culture in Terms of Materials, Built Form, Architectural Style, Landscape, and Urban Morphology, Making Place Different From Each Other

By analyzing the study area of Bida Bin Ammar neighborhood, it is realized that there is a unity in the architectural style for the mixed use blocks in Zone A. All the blocks are similar in architectural design, materials, and colors. Colors are ranged between the white, beige and brown reflecting the sandy nature of the desert environment, and the heritage of Al Ain city. Besides, the name of the buildings is written on the buildings' facades such as: White building, Al Hemairi building, Al Dar building, Al Rawdah building, etc. See Figures 94, 95, and 96. Furthermore, all the mixed-use buildings in Zone A in Bida Bin Ammar neighborhood are following the style of arcade idea. However, a lot of the shops, cafes, and restaurants are using the arched to put their chairs, tables, and bicycles, which make the arcades not serving the pedestrian to experience the place on their foot in a comfortable way. Refer to Figure 97. Indicator 17 is partially achieved in Bida Bin Ammar neighborhood.

Figure 94: Architectural Style of Mixed-Use Blocks in Zone A in Bida Bin Ammar Neighborhood.

a)

b)

Figure 95: Al Hemairi and White Mixed-Use Buildings (a, b) in Zone A in Bida Bin Ammar Neighborhood.

a)

b)

Figure 96: Al Dar and Al Rawdah Mixed-Use Buildings (a, b) in Zone A in Bida Bin Ammar Neighborhood.

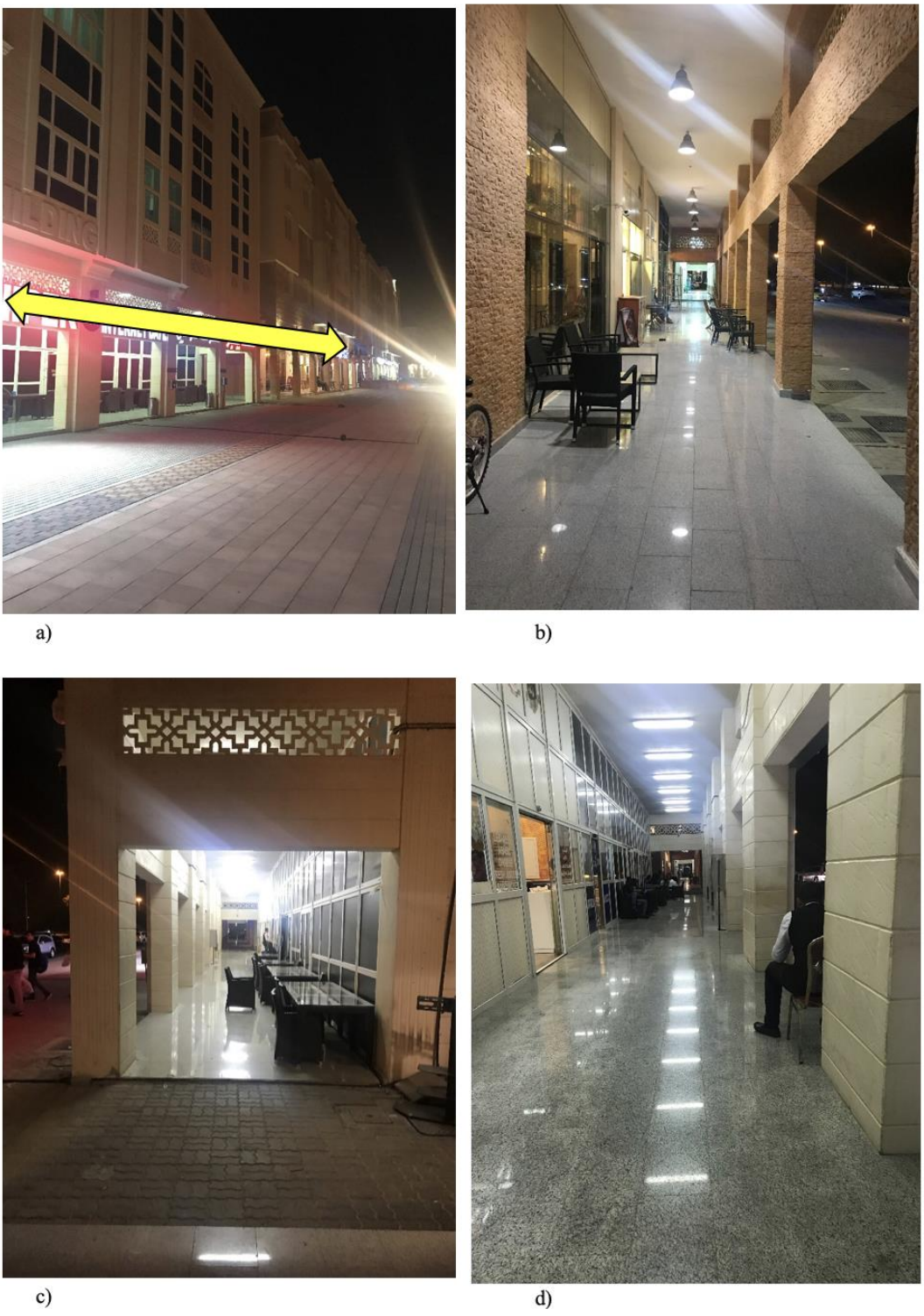


Figure 97: Arcade in the Mixed-Use Buildings (a, b, c, d) in Zone A in Bida Bin Ammar Neighborhood.

Table 29 reveals that Indicator 16 is not achieved, where Indicator 17 is partially achieved. Yet by adding the value that is indicating to not achieve classification for Indicator 16, and the value that is indicating to not achieve classification for Indicator 17, the result is equal to (3+1=4). By dividing 4 by 2, the result is equal to 2, which is matching with the value assigned to weakly achieved classification. Thus, sense of belonging is weakly achieved in Bida Bin Ammar neighborhood. See Table 32.

Table 29: Sense of Belonging Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Personalization (image) of neighborhood depending on what people feel is home terrain, and identified by landmarks.					
Ind.2: Responsiveness to local culture in terms of materials, built form, architectural style, landscape, and urban morphology, making place different from each other.					

6.2.8 Safety and Security

Indicator 1: Reduction of the Fear of Violence, and the Chance of Vehicle/ Pedestrian Accidents (Fear of Accidents)

From the field observation in Bida Bin Ammar neighborhood at the night time, it is observed that there is no proper provision of street lighting in the neighborhood (see Figure 98), which increases the fear of violence, and the chance of vehicle/pedestrian accidents (fear of accidents). Figure 98 displays examples of the

poor provision of street lighting in the neighborhood, which makes the neighborhood unsafe to be walkable at night. Generally, there is a lack of street lighting in the neighborhood. The street lighting is mainly concentrated in the main roads, where the sub roads are lacking the provision of proper street lighting to encourage people to walk in the neighborhood safely. Also, Figure 98 shows that even the area that is surrounding Merdoust restaurant is not properly lighted. The restaurant itself provided the lighting for its outdoor seating area, but the surrounding area is not lighted well, which makes the area unattractive and inaccessible by the people. Therfore, safety and security through the reduction of the fear of violence, and the chance of vehicle/pedestrian accidents (fear of accidents) is weakly acieved in Bida Bin Ammar neighbourhood.

a)

b)

Figure 98: The Poor Provision of Street Lighting in Bida Bin Ammar Neighborhood (a, b).

Indicator 2: The Convenience of Local Facilities, Together with Effective 'Natural' Surveillance of Streets and Walkways 'Eyes on the Street', and the Creation of Places People Find it Pleasant. Active Street Frontages, Public and Private Realm, and Informal Surveillance of the Public Realm Through Having Rooms Facing the Street

By analyzing the study area, it is noticed that most of the neighborhood lacks the effective 'natural' surveillance of streets and walkways (eyes on the street). Moreover, there is a lack of active street frontages (except in Zone A). Besides, wall fences of the residential villas and the wall fences of the farm in Zone B are high, so they are blocking the natural surveillance, as shown in Figure 99. This phenomenon is noticed in the other zones of Bida Bin Ammar neighborhood. Thus, safety and security through effective 'natural' surveillance of streets and walkways 'eyes on the street' is weakly achieved in the neighborhood.

a) b)

Figure 99: The Lack of 'Natural' Surveillance of Streets and Walkways 'Eyes on the Street' in Bida Bin Ammar Neighborhood (a, b).

Indicator 3: Traffic Calming, and Safety within the Neighborhood (During Daytime and after Dark)

As discussed previously in Section 6.2.4 (Indicator 11) traffic calming is partially achieved, where safety within the neighborhood after dark Section 6.2.8 (Indicator 20) is weakly achieved in Bida Bin Ammar neighborhood.

Indicator 4: Ability of People/ Children to Walk or Cycle to School/ Playground/ Friends (Perception of Safety on the Street in the Neighborhood)

From the field observation, it is noticed that in Zone A, it is dangerous to walk in the area of the mixed-use block because the street is crowded as per About walking speed (2020), the street is considered crowded if cars are present at a particular location for more than the time needed for a pedestrian to cross the street at walking speed of 1.39 m/s), which is blocking the pedestrian from walking safely. Many people are buying food and beverage from the cafes and restaurants by ordering and waiting for the order to be delivered to their cars in the middle of the street. This makes the street very crowded since there is not enough parking area. Thus, the crowdedness is leading to the lack of safety on the street in the neighborhood. See Figure 100 for more clarification. Also, Figure 101 shows, the unsafe behaviors of people that are parking their motorcycles and cars in the pedestrian passages, which makes walking very dangerous and unsafe for the pedestrian and especially for children. Figure 102 displays in one image a woman with a baby troll walking in sikkah where other image is showing that there is a car parking in the sikkah which makes the passageway unsafe for the pedestrian. Therefore, safety through the ability of people to walk or cycle to their various destinations in the neighborhood (perception of safety on the street in the neighborhood) is not achieved in Bida Bin Ammar neighborhood.

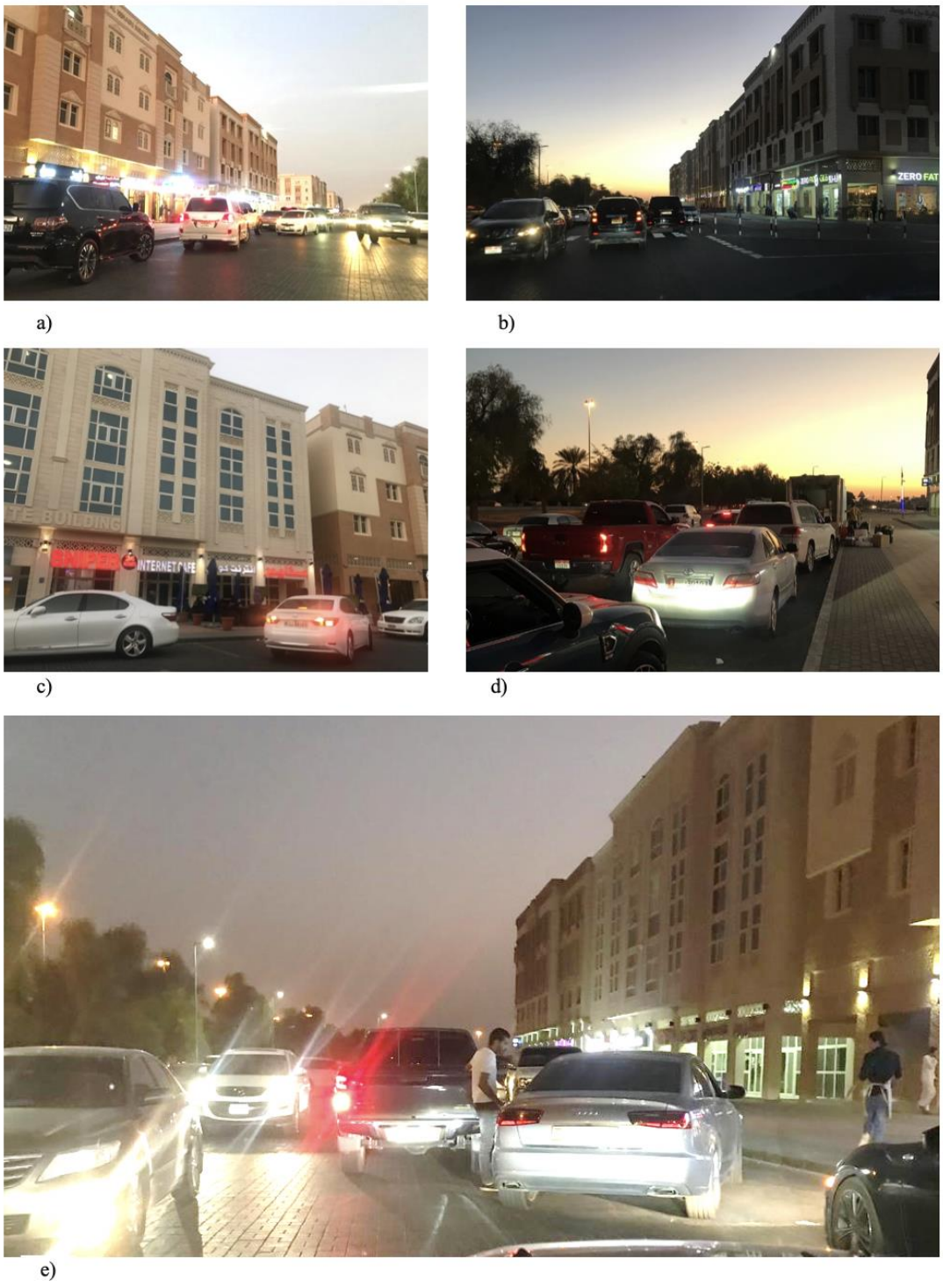


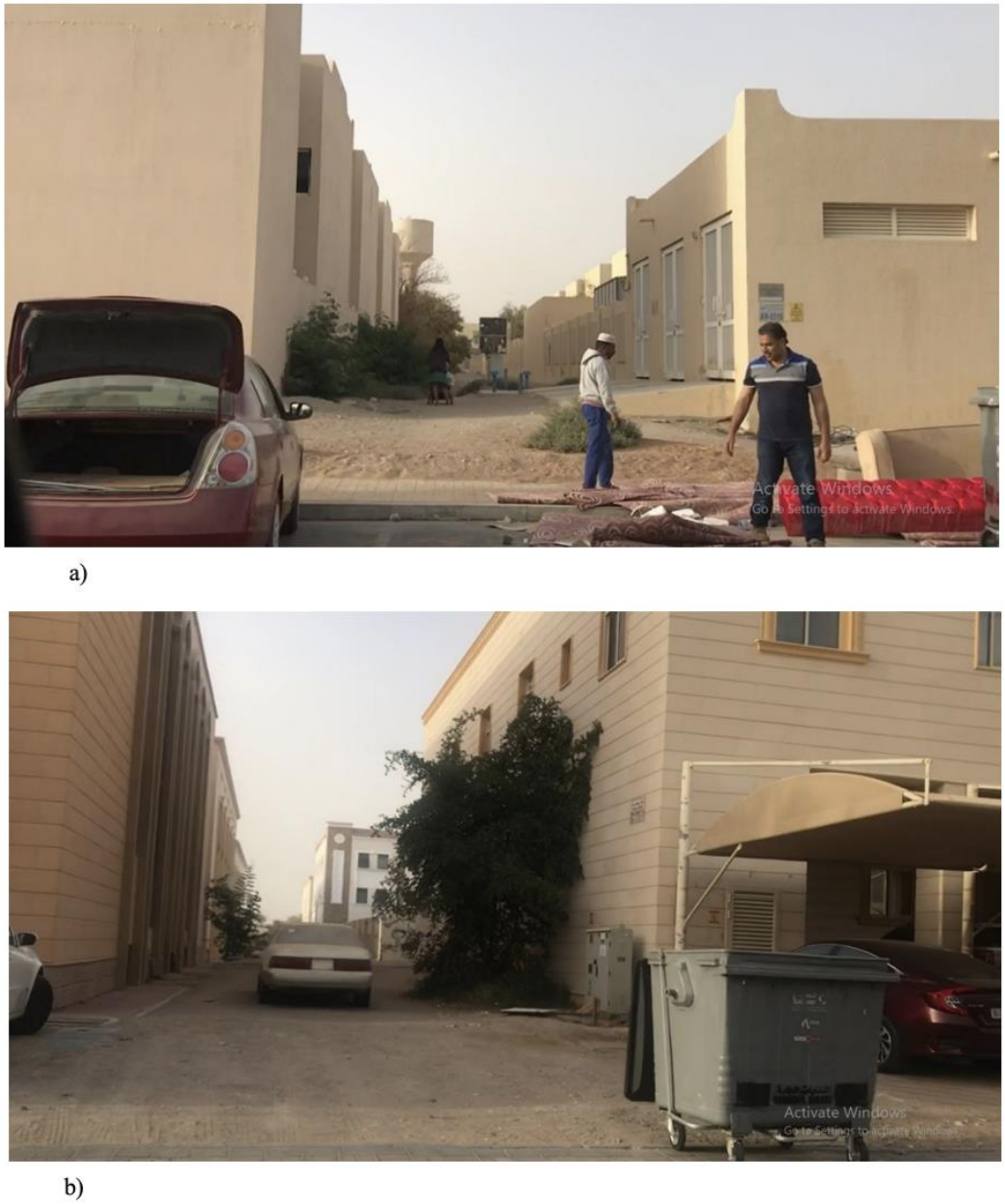
Figure 100: The Overcrowded Street (a, b, c, d, e) in Zone A in Bida Bin Ammar Neighborhood.

a)

b)

c)

Figure 101: Unsafe Parking of Motorcycles and Cars in Bida Bin Ammar Neighborhood (a, b, c).



a)

b)

Figure 102: Unsafe Parking of Cars in Sikkahs (a, b) in Bida Bin Ammar Neighborhood.

At the end, Table 30 clarifies that Indicators 18, 19, and 20 are weakly achieved, where Indicator 21 is not achieved. By adding the three values that are indicating to weakly achieved classification for Indicators 18, 19, and 20, and the value that is indicating to not achieve classification for Indicator 21, the result is equal to

(2+2+2+1=7). By dividing 7 by 4, the result is equal to 1.75, which is approximately matching with the value assigned to weakly achieved classification. Thus, safety and security are weakly achieved in Bida Bin Ammar neighborhood. Refer to Table 32.

Table 30: Safety and Security Assessment.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Ind.1: Reduction of the fear of violence, and the chance of vehicle/ pedestrian accidents (fear of accidents).					
Ind.2: Convenience of local facilities, together with effective 'natural' surveillance of streets and walkways 'eyes on the street'.					
Ind.3: Traffic calming, and safety within the neighborhood during daytime and after dark.					
Ind.4: Ability of people/ children to walk or cycle to school/ playground/ friends.					

6.2.9 Community Participation

Indicator 1: Public Participation in Design, Management, and Volunteer work

Based on the communication with Al Ain City Municipality, they confirmed that community participation in Asharej district was not used at all in the urban densification strategy. Thus, public participation in design, management, and volunteer work is not achieved in Bida Bin Ammar neighborhood.

Table 31: Community Participation Assessment.

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Indicator 1: Public participation in design, management, and volunteer work.					

6.3 Conclusion

In conclusion, this chapter assessed the social sustainability principles and indicators in the study area. The chapter has analyzed the social sustainability principles in the Bida Bin Ammar neighborhood in Asharej district in 2019, based on the conceptual framework of the social sustainability principles and indicators. Moreover, the research tools that were applied for the assessment are field observation, land use maps, Google Earth maps, Al Ain Plan 2030, and analysis of CAD drawings. Furthermore, the Likert scale tool of analysis reflected the findings of the qualitative tools (field observations, and maps analysis), and the numbers were just for the ease of explanation rather than trying to quantify qualitative data. However, only two out of the nine principles of social sustainability might be affected by the subjective assessment of the Likert scale method of analysis (social capital, and sense of belonging), meanwhile, seven principles are assessed based on qualitative tools (field observations and maps analysis, etc.), and some of them such as density are relying fully or partially on quantitative tools (Section 6.2.1). In addition, other social sustainability principles such as mixed-use, accessibility, mobility, quality of life, and safety and security are analyzed based on field observations, maps analysis, and the analysis of CAD drawings (Sections 6.2.2, 6.2.3, 6.2.4, 6.2.6, and 6.2.8). Moreover, based on the field observations (Figure 99), it was noticed that high wall fences are

blocking the natural surveillance. Thus, affecting adversely the principle of safety and security in the study area. On the other hand, the author referred to Al Ain municipality for the investigation of the achievement of the community participation principle in the study area. Check Section 6.2.9 for more clarification. Finally, the analysis showed that mixed-use and accessibility were partially achieved in Bida Bin Ammar neighborhood, where density, mobility, social capital, quality of life, sense of belonging, and safety and security were weakly achieved. On the other hand, community participation was not achieved in the study area. Refer to Table 32 for more details (the yellow color in the table is showing the assessment results of the indicators, where the black color is indicating to the final assessment result of each principle).

Table 32: Summary of Social Sustainability Principles and Indicators.

	Fully Achieved (5)	**Significantly Achieved (4)**	**Partially Achieved (3)**	**Weakly Achieved (2)**	**Not Achieved (1)**
Density					
Ind.1: Gross density.					
Mixed-Use					
Ind.1: Provision of various facilities, and amenities with different activities according to the different local needs.					
Ind.2: Availability of job opportunities, and skills.					
Ind.3: The presence of various housing types.					

Table 32: Summary of Social Sustainability Principles and Indicators (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Accessibility					
Ind.1: Provision of local facilities, and job opportunities.					
Ind.2: Local catchment distance, and good pedestrian accessibility to local services.					
Ind.3: The presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m).					

Table 32: Summary of Social Sustainability Principles and Indicators (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Mobility					
Ind.1: Provision of safe pedestrian walkways and safe cycling routes.					
Ind.2: The presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m).					
Ind.3: Availability of transportation nodes.					
Ind.4: Provision of fast efficient public transport.					
Ind.5: Provision of roads, bus routes, bus stops, network of streets and squares.					
Ind.6: Less permeability use of cars.					

Table 32: Summary of Social Sustainability Principles and Indicators (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Social Capital					
Ind.1: Provision of local facilities.					
Ind.2: Availability of job opportunities.					
Ind.3: Participation in community and social activities.					

Table 32: Summary of Social Sustainability Principles and Indicators (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Quality of Life					
Ind.1: Attraction of the places for living, working, shopping, and enjoyment of the leisure time, and greater access to open space. (Suitable Living Areas and Spaces).					
Ind.2: Provision of fast efficient public transport. (Health).					
Ind.3: Less permeability use of cars. (Health).					
Ind.4: The presence of locally-based energy supply systems, and waste recycling systems. (Health).					
Ind.5: Improvement of air quality, food quality (local production of food), and heathy lifestyles (consumption of fresh fruit, and vegetables from local gardens, and city farms). (Health).					

Table 32: Summary of Social Sustainability Principles and Indicators (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Sense of Belonging					
Ind.1: Personalization (image) of neighborhood depending on what people feel is home terrain, and identified by landmarks.					
Ind.2: Responsiveness to local culture in terms of materials, built form, architectural style, landscape, and urban morphology, making place different from each other.					

Table 32: Summary of Social Sustainability Principles and Indicators (cont'd).

	Fully Achieved (5)	Significantly Achieved (4)	Partially Achieved (3)	Weakly Achieved (2)	Not Achieved (1)
Safety and Security					
Ind.1: Reduction of the fear of violence, and the chance of vehicle/pedestrian accidents (fear of accidents).					
Ind.2: Convenience of local facilities, together with effective 'natural' surveillance of streets and walkways 'eyes on the street'.					
Ind.3: Traffic calming, and safety within the neighborhood during daytime and after dark.					
Ind.4: Ability of people/ children to walk or cycle to school/playground/friends.					
Community Participation					
Ind.1: Public participation in design, management, and volunteer work.					

Chapter 7: Discussion

7.1 Introduction

This chapter explains the data analyzed in Chapters 5 and 6 and shows what measures of urban densification succeeded in achieving social sustainability and what did not work well and why. Besides, the chapter focuses on the findings and aims to make correlations based on the relevant literature discussed throughout this study.

7.2 Interpretation of Research Results

7.2.1 Urban Densification Tools

Chapter 5 answered the first research question and addressed the first objective, which was to investigate the applied urban densification tools in Bida Bin Ammar neighborhoods. Table 22 in Chapter 5 summarized all the findings of urban densification tools on which urban densification has taken place between 2010 and 2019 in Bida Bin Ammar neighborhood in Asharej district. The findings of the data analysis revealed that mixed-use and intensification were weakly applied in Bida Bin Ammar neighborhood. Besides, mixed housing and infill development were partially applied in the study area. Refer to Table 1 in Appendix A to view the applied tools of urban densification in each zone of the five zones in the study area. From Table 1 in Appendix A, it is evident that although mixed-use was weakly applied in the Bida Bin Ammar neighborhood, the most prominent method of mixed-use as a densification tool in the neighborhood since 2010 was the horizontal mixed-use. Since it was applied variously in the five zones. Additionally, vertical mixed-use and mixed-use walkable areas were weakly applied in the neighborhood because they are only partially applied in Zone A and not applied in the rest four Zones (B, C, D, and E). In addition, the

results display that intensification is another urban densification tool that was weakly applied in Bida Bin Ammar neighborhood. Table 1 in Appendix A displays that subdivision of property and vertical extension were not applied in all zones in the study area. Nevertheless, consolidation was weakly applied in the neighborhood. Table 11 in Chapter 5 demonstrated that joining together more than one lot to create a new single lot (consolidation) was weakly applied in Zones A, B, and E and not applied in Zones C and D. Also, the results clarify that horizontal extension was weakly applied in Bida Bin Ammar neighborhood. The findings show that the increase of bulk rights densification tool was not applied in Bida Bin Ammar neighborhood. Table 13 in Chapter 5 indicated that adding extra area to the house by extending current balconies (closing the current balconies) was variously applied in Zones A, B, D and E, and not applied in Zone C. In addition, Table 14 in Chapter 5 clarified that increasing the bulk (mass) rights pertaining to a specific property by extending buildings' front and side facades, and rear extension for single-family houses, was weakly applied in Zones A, C, D, and E, and not applied in Zone B. Thus, intensification through horizontal extension (increase of bulk rights densification tool) was not applied in the study area. Refer to Table 17 in Chapter 5. Moreover, providing additional units to the existing house (either detached structures or attached external structures) was weakly applied in Zones A, B, D, and E, and not applied in Zone C. See Table 16 in Chapter 5. Therefore, intensification through horizontal extension (attached / detached second dwelling) was weakly applied in Bida Bin Ammar neighborhood in Asharej district. See Table 17 in Chapter 5. On the other hand, the results indicate that mixed housing was partially applied in the study area. Although mixed housing (types) was applied variously in all the zones as shown in Table 8 in Chapter 5, mixed housing (tenure) was not applied in the five zones as clarified in Tables 5 and 6 in Chapter 5. Also, the

findings show that social housing was not available in all the five zones, and the ability to own houses by the families is not applied in all zones. Besides, the only form of tenure that is prevailed in Bida Bin Ammar neighborhood is the rent, and it is common in the five zones. Finally, the study results reveal that infill development is another urban densification tool that was partially applied in Bida Bin Ammar neighborhood since 2010. This is because development of vacant parcels and demolition and reconstruction were variously applied in all the zones in the study area. See Tables 19 and 20 in Chapter 5 for more details.

7.2.2 Social Sustainability Principles and Indicators

Chapter 6 addressed the second objective, which was to identify social sustainability principles and indicators on the urban community level. The chapter has analyzed the social sustainability principles in the Bida Bin Ammar neighborhood in Asharej district in 2019, based on the conceptual framework of the social sustainability principles and indicators. Table 32 in Chapter 6 summarized all the findings of the social sustainability principles and indicators. The results show that mixed-use, and accessibility were partially achieved, where, density, mobility, social capital, quality of life, sense of belonging, and safety and security were weakly achieved. However, community participation was not achieved in Bida Bin Ammar neighborhood. The results reveal that density was weakly achieved in Bida Bin Ammar neighborhood. Since the calculated gross density in 2010 and 2030 was below 40 to 50 person per hectare, the density in Bida Bin Ammar neighborhood is considered as low. In addition, Table 24 in Chapter 6 demonstrated that the provision of various facilities, and amenities with different activities according to the different local needs (Indicator 1), and the availability of job opportunities (Indicator 2) were partially achieved in

Bida Bin Ammr neighborhood, where the presence of various housing types (Indicator 3) was significantly achieved in the study area. Yet as per the assessment of the results which was done in Chapter 6, mixed-use was partially achieved in the study area. Moreover, the results indicate that accessibility was partially achieved in Bida Bin Ammar neighborhood. This is because it was variously achieved in the study area. Table 25 in Chapter 6 revealed that the provision of local facilities, and job opportunities (Indicator 1) was partially achieved, and the local catchment distance and pedestrian accessibility to local services (Indicator 2) was significantly achieved in the study area, where (Indicator 3) the presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m) was not achieved in Bida Bin Ammar neighborhood. Besides, the findings of the data analysis revealed that mobility was weakly achieved in the study area. This is because the provision of safe pedestrian walkways and safe cycling routes (Indicator 1) was not achieved in the neighborhood. Besides, (Indicator 2) the presence of public transportation within average walkable distance to the nearest bus stop (300 – 400 m) was not achieved. Also, the availability of transportation nodes, and the provision of fast efficient public transport (Indicator 4) was not achieved in Bida Bin Ammar neighborhood. However, the provision of roads, bus routes, bus stops, network of streets and squares (Indicator 5) was weakly achieved, where the less permeability use of cars (Indicator 6) was partially achieved in the study area. See Table 26 in Chapter 6. Furthermore, the findings related to social capital show that it was weakly achieved in Bida Bin Ammar neighborhood. Table 27 in Chapter 6 clarified that the provision of local facilities, and the availability of job opportunities were partially achieved, where participation in community and social activities was not achieved in the study area. Refer to Chapter 6 (Section 6.2.5 – Indicator 3) for more details. Additionally, the findings that are

related to the quality of life show that it was weakly achieved in Bida Bin Ammar neighborhood. This is because the provision of fast efficient public transport (Indicator 2), and the improvement of air quality, food quality (local production of food), and heathy lifestyles (Indicator 5) were not achieved in the study area. However, attraction of the places for living, working, shopping, and enjoyment of the leisure time, and greater access to open space (Indicator 1), and less permeability use of cars (Indicator 3) were partially achieved in the neighborhood, where the presence of locally-based energy supply systems, and waste recycling systems was weakly achieved in Bida Bin Ammar neighborhood. See Table 28 in Chapter 6 for more details. Moreover, it is important to highlight that the presence of locally-based energy supply systems (Barton, 2000), and waste recycling systems (Barton, 2000), improve the quality of the environment, and the people health and wellbeing due to the control of pollution, and make the community more attractive place for people to live, work, study, and spend leisure time (Popovic & Kraslawski, 2018). Refer to Chapter 1 (Section 1.3.6) for more explanation. As well, the results reveal that safety and security is another social sustainability principle that was weakly achieved in Bida Bin Ammar neighborhood. This is because the perception of safety on the street in the neighborhood (Indicator 4) was not achieved in the study area. Refer to Chapter 6, Section 6.2.8 for more clarification. However, reduction of the fear of violence (Indicator 1), and the convenience of local facilities, together with effective 'natural' surveillance of streets and walkways 'eyes on the street' (Indicator 2), and traffic calming, and safety within the neighborhood during daytime and after dark (Indicator 3) were weakly achieved in the neighborhood. Refer to Table 30 in Chapter 6. Furthermore, the findings related to sense of belonging display that it was also weakly achieved in the study area. Table 29 in Chapter 6 displayed that the personalization (image) of neighborhood depending on

what people feel is home terrain (Indicator 1) was not achieved, where responsiveness to local culture in terms of materials, built form, and architectural style (Indicator 2) was partially achieved in the study area. Finally, community participation in design, management, and volunteer work was not achieved in Bida Bin Ammar neighborhood as Al Ain City Municipality confirmed that community participation in Asharej district was not used at all in the urban densification strategy. See Table 32 in Chapter 6.

7.3 Impact of the Application of Urban Densification Tools on the Social Sustainability Principles in Bida Bin Ammar Neighborhood

7.3.1 Impact of Mixed-Use Urban Densification Tool on Social Sustainability Principles

According to Dave (2011), the mix of uses of a neighborhood is a variable that interacts with density and can affect the sustainability principles. Horizontal mixed-use through the provision of a mixture of different single-use buildings was partially applied in Bida Bin Ammar neighborhood and affected positively in increasing the population density in the neighborhood. On the other hand, vertical mixed-use, and mixed-use walkable areas had a negative impact on the density principle because mixed-use blocks were only available in Zone A, which created parking problems due to the crowdedness. Also, it resulted in a lack of safety and security. These problems that resulted from the high density due to the uneven distribution of mixed-use blocks in the neighborhood are in line with disadvantages of the high density that were conducted in 2013 by the Ethekwini Municipality. Refer to Figure 4 in Chapter 1. Moreover, the partial application of horizontal mixed-use in the neighborhood affected positively on the achievement of mixed-use principle, but the application of vertical mixed-use, and mixed-use walkable areas in Zone A only without the rest of the zones was the main impact of the weakly achievement of mixed-use principle in the study

area. This is because the concentration of the mixed-use blocks was only in Zone A, which led to concentrate the provision of various services such as retails, banks, restaurants, cafes, and job opportunities to be in Zone A more than the other zones. Thus, a proper study and policy should be applied to take in consideration the right distribution of the local services in the neighborhood. Besides, mixed-use had a positive contribution in the provision of facilities and job opportunities. As a result, mixed-use enhanced the accessibility principle in Bida Bin Ammar neighborhood. Hence, this finding is consistent with what was mentioned in Chan's and Lee's study in 2008, which indicated the importance of accessibility in achieving social sustainability. Furthermore, as analyzed in Chapter 6 in Section 6.2.4, there is a dominant reliance on car use in the neighborhood without proper provision of pedestrian walkways, footpaths, cycling routes, and sikkas to be safe, shaded, pleasant, and well maintained for the pedestrians. Therefore, the result disagreed with what Barton (2000) mentioned. Additionally, mixed-use had a positive impact on the achievement of social capital principle due to the provision of local facilities and job opportunities, which allowed people to interact with each other in their everyday lives. Besides, mixed-use contributed effectively in enhancing the quality of life, since the presence of various services and job opportunities attract the people to live and work in the neighborhood. This result agrees with Barton (2000). Further, mixed-use contributed positively to the achievement of sense of belonging social sustainability principle through the presence of different housing types in the neighborhood. On the other hand, mixed-use had a negative impact on the study area regarding the safety and security principle, as analyzed in Chapter 6 in Section 6.2.8. This is due to the problems resulted from locating the mixed-use blocks only in Zone A without the other zones in the neighborhood. Accordingly, this led to major issues related to the

congestion and overcrowding by cars, which made the place unsafe to walk and cross. Also, the horizontal mixed-use that was applied inside the neighborhood didn't help the people feel safe and secure to walk, which contradicts with Barton (2000). Lastly, the application of the mixed-use tool in the study area could not determine whether the community participation principle was achieved.

7.3.2 Impact of Mixed Housing Urban Densification Tool on Social Sustainability Principles

The significance application of various mixed housing types in all zones helped in creating different densities in the neighborhood and attracting people to live in several housing types. Therefore, mixed housing types affected positively on the density principle, and agrees with the study of Dave (2011), that clarified the interconnected relationship between the density of people and density of buildings as the increase of density in one results in an increase of density in the other. However, the only form of tenure in the study area is the rent, with no opportunity of owning properties. Besides, social housing was not applied in all the zones of the study area. Additionally, the partial presence of mixed housing types in all zones in Bida Bin Ammar neighborhood as analyzed in Chapter 5 in Section 5.2.5, contributed positively in enhancing the achievement of the mixed-use principle in the study area. As a result, the application of mixed housings types goes in line with the study of Urban sprawl (2014) that highlighted the importance of varied housing options for everybody. Moreover, the availability of different housing types in all zones affected positively and provided a greater access to the neighborhood due to the various options of housing types that are available in the study area. Thus, mixed housing affected in a positive way in developing the accessibility principle in Bida Bin Ammar neighborhood, and agrees with Chan and Lee (2008), about the importance of

achieving accessibility in the neighborhood. Furthermore, mixed housing types took a positive part in the weak achievement of mobility and social capital social in the study area, because it developed the access to the neighborhood, attracted the people to live and work too, and encouraged the public to interact. As a result, the presence of mixed housing types in the study area worked in with the research of Chan and Lee (2008), which shed light on the importance of achieving mobility and social capital within the community to be sustainable. In addition, the variety of housing types in the study area affected positively on the weak achievement of quality of life principle. This is because the availability of various housing types creates suitable living areas and attracts people to live and work in the neighborhood. Thus, the application of mixed housing types in Bida Bin Ammar neighborhood helps in achieving what mentioned in the study of Popovic and Kraslawski (2018), which indicated the significance of quality of life in community development and in achieving social sustainability. Also, the presence of various housing types that are responsive to local culture in terms of colors, materials, built form, and architectural style enhanced the sense of belonging in the Bida Bin Ammar neighborhood and goes in line with what mentioned (Barton, 2000). Besides, the application of mixed housing types in Bida Bin Ammar neighborhood had a positive impact on safety and security in the neighborhood, because it created access to various housing opportunities that attract people to live in a more livable neighborhood. Also, it agrees with Chan and Lee (2008) that clarified the importance of achieving the safety and security social sustainability principle in the community. As a result, the livability and interaction of people enhance the sense of safety and security in the study area. In the end, the application of the mixed housing tool in Bida Bin Ammar neighborhood could not determine whether the community participation principle was achieved.

7.3.3 Impact of Intensification Urban Densification Tool on Social Sustainability Principles

Intensification participated in enhancing the density in Bida Bin Ammar neighborhood through the consolidation and horizontal extension via increase of bulk rights and the presence of attached/detached second dwelling as analyzed in Chapter 5 in Sections 5.2.7 and 5.2.9. This goes in line with Cubitt (2008) that clarified that the addition of a dwelling to the existing one contributes to increasing the residential density in the community. Therefore, intensification helped increase housing units, and the population density in the study area. Moreover, intensification didn't succeed in achieving the mixed-use principle in the neighborhood, because in consolidation, the application of the tool was happening to construct new apartment blocks instead of single family houses. Thus, only one type of use which is residential was applied. Also, in the horizontal extension via bulk rights and the attached/detached second dwelling, the change and addition was done for the same block (same use). Thus, intensification didn't affect the achievement of mixed-use principle in Bida Bin Ammar neighborhood. In addition, since the intensification method that was applied in the study area through consolidation and horizontal extension via increase of bulk rights and the presence of attached/detached second dwelling was only happened within the same plot, so intensification didn't affect the accessibility and mobility principles. Furthermore, as mentioned by Yoo and Lee (2016), social capital exists through interactions and in networks among people. Thus, it is related to physical factors, and therefore, space for interaction is needed, and this indicates the significance of the environment in the process of developing social capital in the neighborhood. Many studies have found a significant relationship between social capital and the key concepts in achieving social sustainability in the built environment such as density,

meeting places, a mix of housing types, equitable access to services, and mix of land-use (Yoo & Lee, 2016). Accordingly, intensification through consolidation contributed positively in achieving the social capital principle, due to the construction of new apartment blocks instead of single-family houses, which increased the residential density in the study area, and created an appropriate atmosphere for people to interact. Thus, intensification enhanced the people's interaction and the social capital principle accordingly and supported the research of Dave (2011) that indicated the significance of social interaction for sustainability in the community. Additionally, intensification through consolidation (by the construction of hundred percent apartment blocks) increased the affordability of housing units, and as a result, enhanced the quality of life by making the neighborhood a more attractive living place. This outcome agrees with (Barton, 2000). As per Perrin and Grant (2014), the presence of various housing types such as apartment blocks promotes urban sustainability and resilience. Besides, mixing housing types increases housing opportunities and social interaction and integration in the community. It also encourages economic benefits, such as affordability, and local governments support the application of different housing types (Perrin & Grant, 2014). Thus, it improves the quality of the environment and makes the community a more attractive place for people to live (Popovic & Kraslawski, 2018). Also, since social sustainability and the neighborhood built environment are logically connected through physical factors such as a mix of housing types, and equitable access to services (Yoo & Lee, 2016), quality of life as an important aspect of social sustainability can be achieved through the enhancement of the physical environment (Popovic & Kraslawski, 2018). Furthermore, intensification had a negative impact on the identity and sense of belonging in the neighborhood. This is because intensification via consolidation resulted in the demolition of the old style of

single-family houses to construct different types of designs. This result contradicts what was mentioned by Chan and Lee (2008), about the importance of respecting and conserving the local characteristics of the community. As well, intensification through the consolidation and horizontal extension via increase of bulk rights and the presence of attached/detached second dwelling affected negatively on the safety and security principle, because it resulted by a lack of natural surveillance on streets and walkways, and led to a lack of active street frontages. This is because of the high wall fences of the villas, the closed balconies to add an extra area to the houses. Also, the application of the attached/ detached second dwelling limited the 'eyes on the street', and thus, increased the perception of fear of unsafety within the neighborhood. This result contradicts (Barton, 2000) that highlighted the importance of designing the places for people to be safe and pleasant for them to walk with efficient natural surveillance of streets and walkways. Finally, the application of the intensification tool in the study area could not determine whether the community participation principle was achieved.

7.3.4 Impact of Infill Development Urban Densification Tool on Social Sustainability Principles

Infill development of vacant parcels was the most dominant form of urban densification in the neighborhood since 2010, which contributed positively to increasing density in the neighborhood due to its application in all the zones. Also, infill demolition and reconstruction applied in all zones, since the direction was to convert the single-family houses to hundred percent built-up area (apartment blocks). This result agrees with the study of Dave (2011), that mentioned that higher density requires a higher ratio of buildings to a given land area, and this results in increasing residential density and affects socially. Besides, this result goes in line with Al Ain Plan 2030 that applied the infill development mainly as a primary tool for urban

densification. In addition, the application of demolition and reconstruction of mixed-use blocks only applied in Zone A, without the other four zones. Thus, applying mixed-use blocks only in Zone A had a negative impact in the study area because most of the services concentrated in Zone A, which created problems of crowdedness. This is because most of the services were cafes, and restaurants, where cars were accumulating to order. This made the street unsafe for pedestrians to walk, and created parking issues because the place was not designed to be drive-through. This result contradicts what was introduced in the research of Pendola (2017), who mentioned that Jacob discussed that mixed-use could make the neighborhood safer. Thus, proper distribution of services needs to be considered in the neighborhood. Moreover, infill through vacant parcels, and demolition and reconstruction allowed to provide various services for residents, as analyzed in Chapter 5 in Sections 5.2.11 and 5.2.12. This affected positively in achieving the accessibility principle. This result supports the argument of Chan and Lee (2008), and Pitarch-Garrido (2018), about the role of services provision in achieving accessibility principle and enhancing social sustainability. Furthermore, according to Barton (2000), the presence of facilities, services, and jobs can reduce the travel distance and the reliance on the car in the neighborhood. Infill development either by vacant parcels or demolition and reconstruction allowed for the provision of various services and facilities and local jobs, but it was not applied properly in the study area, because most of the services were allocated in the mixed-use blocks in Zone A only. This resulted in the reliance on the car instead of encouraging the people to walk in the neighborhood. Thus, proper distribution of services and facilities encourages the walkability and reduces the travel distance and reliance on the car in the neighborhood. Additionally, infill through vacant parcels, and demolition and reconstruction increased the density, provided

various services, facilities, and job opportunities that enhanced the people interaction, and the social capital principle accordingly. Thus, this result agrees with the study of Garrigos-Simon, Botella-Carrubi, and Gonzalez-Cruz (2018) that shed light on the role of the achievement of social capital in forming a sustainable community. Likewise, infill through vacant parcels, and demolition and reconstruction provided various services, facilities, and job opportunities, which made the study area an attractive place for people to live. This outcome agrees with what mentioned by (Barton, 2000). Moreover, infill through vacant parcels had a positive impact on the sense of belonging in the study area, because the development of vacant parcels reflected the use of local materials and there was a response to the local culture by the use of colors, and architectural style. Thus, the result respected the unique characteristics of the local culture in Bida Bin Ammar neighborhood and agrees with what mentioned by Barton (2000), about the significance of respecting the unique characteristics of the neighborhood. On the other hand, infill through demolition and reconstruction affected negatively on the identity and sense of belonging principle in the neighborhood. This is because of the demolition of the old-style single-family houses to construct different types of designs. This outcome disagrees with Chan and Lee (2008) that clarified the significance of conserving the local characteristics of the community. As well, infill through demolition and reconstruction of mixed-use blocks didn't create a safe environment for pedestrians and children to walk or cycle to their daily destinations (schools, supermarkets, etc.). Also, the car congestion problems associated with the construction of mixed-use blocks in Zone A created a fear of accidents. Therefore, infill through demolition and reconstruction affected negatively on the safety and security principle in the study area. This result agrees with what mentioned by Barton (2000). In conclusion, the application of the infill development tool in the

neighborhood could not determine whether the community participation principle was achieved.

7.4 Conclusion

In conclusion, this chapter discussed the results of urban densification tools, and the social sustainability principles and indicators. Besides, the chapter investigated the impact of the application of urban densification tools (mixed-use, mixed housing, intensification, and infill development) on the social sustainability principles in the Bida Bin Ammar neighborhood in Asharej district. Moreover, it is important to highlight that the Likert scale reflected the findings of the qualitative tools such as maps analysis, and field observation, etc., and the author used the numbers of the Likert scale just for the ease of explanation rather than trying to quantify qualitative data. Furthermore, the results that are related to the applied tools of urban densification in Chapter 5 were assessed based on qualitative tools such as field observations and maps analysis. Besides, in Chapter 6, only two out of the nine principles of social sustainability might be affected by subjective assessment (social capital, and sense of belonging), meanwhile, seven principles were assessed based on qualitative tools and some of them such as density were relying fully or partially on quantitative tools, while the rest of principles were analyzed based on field observations, maps analysis, and the analysis of CAD drawings, etc. Refer to Chapter 6 - Sections (6.2.1 - 6.2.4), 6.2.6, 6.2.8, and 6.2.9 for more details. However, the following chapter revisits the research problem and tackles the conclusions of the study.

Chapter 8: Conclusions, Recommendations, and Further Research

8.1 Introduction

This chapter answers the research questions and objectives and revisits the research problem. Besides, it gives conclusions and makes recommendations for the future development of the Bida Bin Ammar neighborhood in Asharej district and possible further research.

8.2 Recap the Research Problem

In Al Ain, urban sprawl is a problem associated with low density and reliance on car use. Urban densification is a sustainable planning approach that can counter issues of urban sprawl. However, although urban densification is a sustainable solution that can limit the urban sprawl, but still it has its pitfalls that should be considered while applying it to the development of the neighborhood. Thus, determining what measures of urban densification succeeded in achieving social sustainability in the study area and what did not work well and why since 2010 as per the vision of Al Ain Plan 2030 is important to minimize the consequences for future development. In this study, the aim was to explore the impact of the application of urban densification tools on social sustainability to cover the gaps of the densification strategy and to propose recommendations for the problems associated with this phenomenon. To attain the research aim, the first objective was to investigate the applied urban densification tools in the Bida Bin Ammar neighborhood. Data collected from Google Earth maps and field observations. The findings of urban densification tools on which it has taken place between 2010 and 2019 in Bida bin Ammar neighborhood recorded in Chapter 5. Besides, the first research question which was about the applied urban densification

tools in Bida Bin Ammar neighborhood as an example of neighborhoods going under transformation towards urban densification was answered in Chapter 5. However, the most prominent tools of densification in the study area since 2010 were the infill development and mixed housing. This was followed by the mixed-use and intensification tools. The second objective was to identify social sustainability principles and indicators on the urban community level. Investigation tools that were used in the analysis were Google Earth maps, Al Ain Plan 2030, land use map, field observations, census, and analysis of CAD drawings. Table 10 in Chapter 6 recorded the extent of the achievement of social sustainability principles and indicators in the study area in 2019. Mixed-use, and accessibility were partially achieved in Bida Bin Ammar neighborhood, where density, mobility, social capital, quality of life, sense of belonging, and safety and security were weakly achieved. However, community participation was not achieved in the study area. Chapter 7 addressed the third objective of the research, which was to explore the positive and negative impacts of the applied urban densification tools in Bida Bin Ammar neighborhood on social sustainability. Also, the second research question was answered in Chapter 7. The final objective was to identify the measures and tools of urban densification by exploring urban densification implementation policies and strategies to assess and guide existing development policies to achieve social sustainability. Thus, the final objective was to make recommendations on the appropriate and well-studied implementation of the densification strategy for the future development of the Bida Bin Ammar neighborhood in Asharej district. The following section is discussing the recommendations and possible further research. Concerning the vision of Al Ain Plan 2030, the land-use framework plan concentrated on the infill redevelopment, and it took into consideration the creation of dense mixed-use development into nodes along

a corridor that is running between two wadis in Al Ain City. The nodes are consisting of four-story multi-family housing with offices and retail to create transit viable. This planning strategy of Al Ain 2030 is to accommodate the future growth of the residential and commercial demand of the city. Based on the results of the study, the author concludes that urban densification has been a prominent method in Bida Bin Ammar neighborhood in Asharej district since 2010. However, infill development and mixed housing urban densification tools were partially applied in the study area. This was followed by the mixed-use and intensification tools that were weakly applied in the neighborhood. Chapter 5 analyzed in details the application of the urban densification tools in Bida Bin Ammar neighborhood in the five Zones (A, B, C, D, and E). On the other hand, the applied urban densification tools in Bida Bin Ammar neighborhood had positive and negative impacts on social sustainability, as discussed in Chapter 7. Thus, there is a dichotomy of urban densification, where although according to various urban theories, it is a sustainable solution to limit the urban sprawl, but still it has its pitfalls that should be considered as a challenge in the planning for any future development. Therefore, the next section is going to propose some recommendations that could guide the local authorities and urban planners, to understand what makes a neighborhood socially sustainable. These recommendations are mainly based on the results of this research and from the problems associated with the application of the urban densification tools in Bida Bin Ammar neighborhood (Mixed-use, mixed housing, intensification, and infill development).

8.3 Recommendations and Further Research

Based on the focus of the land-use framework plan of Al Ain Plan 2030, that is related to create a dense mixed-use development (four-story multi-family housing with offices and retail to create transit viable) into nodes along a corridor that is

running between two wadis in Al Ain City. This application of Al Ain Plan 2030 was applied in Bida Bin Ammar neighborhood in Asharej district in Zone A as analyzed in Chapter 5. This distribution of the mixed-use blocks as per Al Ain Plan 2030 to be only in Zone A created parking problems due to the crowdedness. Also, it resulted in a lack of safety and security. These problems resulted from the high density due to the uneven distribution of mixed-use blocks in the neighborhood. Thus, it is recommended that the local authorities should be designing their strategies and planning polices to fit the context nature to avoid any conflict regarding the distribution of the mixed-use blocks in the neighborhood. Besides, most of the services that were provided in the mixed-use blocks in Zone A in the study area were restaurants and cafes. This was the main issue of the crowdedness that happened by cars because people are coming to take their food orders. Therefore, it is recommended from local authorities to study the types of services and facilities that can serve an area. In Zone A in Bida Bin Ammar the place was not designed to be a drive-through area. Thus, a control of the types of services of the mixed-use blocks should be considered in designing and planning strategies to achieve a functionally viable mixed- use neighborhoods. Furthermore, the results of this research revealed that community participation and social capital principles were not achieved. Thus, local guidelines should ideally incorporate the holistic principles of densification, such as community participation to allow the residents of the neighborhood to participate during the urban design process of their neighborhoods. This will help in meeting public needs and achieving a development that is socially sustainable. Moreover, the findings show that the only form of tenure in Bida Bin Ammar neighborhood is the rent, with no opportunity for owning properties. So, it is recommended that local authorities provide a mixed tenure of housing that can allow for owning besides renting to create different densities in the

neighborhood and to attract people to live in several housing types. In addition, the application of the attached/ detached second dwelling limited the ‘eyes on the street’, and thus, increased the perception of fear of unsafety within the neighborhood. Thence, it is recommended to have active street frontages such as Zone A in the study area to enhance the safety and security principle in the neighborhood. Finally, the results indicate that there is a dominant reliance on car use in the neighborhood without proper provision of pedestrian walkways, footpaths, cycling routes, and sikkas to be safe, shaded, pleasant, and well maintained for the pedestrians. Therefore, it is recommended not to keep any sikka or leftover space without a proper design that is safe and well-maintained. This is to encourage friendly modes of movement (walkability and cycling) and to limit the reliance on car use in the neighborhood.

Based on the focus of the literature used for this study, it is evident that the author studied several social sustainability principles. Some elements might be missing in the social sustainability principles. Besides, a large portion of the work is dedicated to analyzing the urban densification tools and its implications on social sustainability principles. Therefore, it may be valuable for future research to focus on studying other social sustainability principles, and to study the social impact and implications of urban densification in Bida Bin Ammar neighborhood in Asharej district by doing interviews with decision-makers and planners in Al Ain City Municipality (AACM), and the application of survey questionnaires to the residents of the neighborhood to understand their basics needs that could be implemented in the future design and planning process. Furthermore, some of the social sustainability principles in the study could not be completely assessed by only relying on the adapted tools. These include social capital, and a sense of belonging, where the analysis is still an intuitive subjective assessment that needs more verification in further research. These two

principles are recommended to be further investigated with more appropriate tools such as questionnaires in future research. Social capital increases by walkability and by creating more opportunities for people to meet and this by providing social hubs and various facilities and amenities with different activities according to the different needs such as open spaces, Masjids, etc. However, it needs more tools for investigation in further research. As per Yoo and Lee (2016), in the planning policies, there is a lack of awareness about spatial elements that can affect social sustainability. Therefore, the provision of space for people interaction enhances social capital, especially bonding social capital. Additionally, Yoo and Lee (2016) mentioned that walkability, land use, density, and neighborhood type, have relationships with social capital. Besides, a sense of community that is associated with the overall satisfaction of residents with the community is related to the norms or values of the community, which is related to perceived neighborhood environment quality, and social capital.

Finally, it is important to address the significance of this study not only for Al Ain city but also for the larger UAE context. Similar urban forms such as Abu Dhabi are suffering from urban sprawl. According to Abu Dhabi Plan 2030, Al Shawamekh, Musaffa Al Senaaya, Musaffah Al Shabyyah, Bani Yas, Al Bateen, and Al Shamkha Old are low-density areas characterized by low rise buildings, and urban sprawl (low density 3-5 units/gross hectares, buildings height range is 3 to 5 storeys). Besides, they are planning to encounter urban sprawl by urban densification in Al Bateen through the planning of the implementation of mixed-use developments, while the tool of densification in Al Shamkha is the infill development. Therefore, much of the information and analysis conducted in this thesis have relevance for the UAE context and its urban areas as a whole, and thus the results of this study can be generalized and applied to other neighborhoods with similar characteristics. This kind of research helps

in ensuring that the positive and negative impacts of densification, as well as the concerns of local residents, are taken into consideration to guide spatial planning policies.

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Appendices

Appendix A

Table 33: Conceptual Framework of Urban Densification Tools.

UD Tools No.	Tools of Urban Densification	Indicators	Tools of Investigation of the Application	Application in the Study Area (Bida Bin Ammar Neighborhood in Asharej District)
1	**Mixed Use**			
	1.1 Horizontal Mixed Use: Different uses in different buildings.	1.1.1 Providing a mixture of different single-use buildings. Community facilities with different functions and activities.	Google Earth maps, and field observations.	Applied in all zones.
	1.2 Vertical Mixed Use: Different uses in a single building.	1.2.1 Introducing Mixed-Use multi-story blocks that have different uses within a single building.	Google Earth maps, and field observations.	Applied only in zone A. Zones B, C, D, and E are not applicable.
	1.3 Mixed Use Walkable Areas: Combining both horizontal and vertical mixed uses.	1.3.1 Combining both horizontal and vertical mix of uses in an area.	Google Earth maps, and field observations.	Applied only in zone A. Zones B, C, D, and E are not applicable.

Table 33: Conceptual Framework of Urban Densification Tools (cont'd).

UD Tools No.	Tools of Urban Densification	Indicators	Tools of Investigation of the Application	Application in the Study Area (Bida Bin Ammar Neighborhood in Asharej District)
2	**Mixed Housing**			
	2.1 Mixed Tenure: Tenure is the term to describe how a home is held or occupied. Typically they are owned or rented by the family.	2.1.1 Providing the ability to own or rent by the families (mix of forms and tenures of housing).	Field observations.	Rent is the only form of tenure that is dominant in all the zones.
		2.1.2 Providing private and social housing as a part of the development project.	Field observations.	Social housing is not applied in all the zones.
	2.2 Mixed Housing Types: A range of housing types, which includes detached and multiple units.	2.2.1 Providing various housing types and opportunities (single-family detached dwellings, semi-detached dwellings, walk-ups apartment blocks, and mixed-use blocks).	Field observations.	Applied variously in all zones.

Table 33: Conceptual Framework of Urban Densification Tools (cont'd).

UD Tools No.	Tools of Urban Densification	Indicators	Tools of Investigation of the Application	Application in the Study Area (Bida Bin Ammar Neighborhood in Asharej District)
3	**Intensification**			
	3.1 Subdivision of Property: Subdivision is the activity of making smaller titles out of larger titles.	3.1.1 Allowing to subdivide a large parcel of land into two or more further parcels.	Google Earth maps.	Not applied in all zones.
	3.2 Consolidation: The consolidation of property is where two or more properties are consolidated under the same property number.	3.2.1 Joining together more than one lot to create a new single lot.	Google Earth maps.	Applied in zones: A, B, and E. Zones C and D are not applied.

Table 33: Conceptual Framework of Urban Densification Tools (cont'd).

UD Tools No.	Tools of Urban Densification	Indicators	Tools of Investigation of the Application	Application in the Study Area (Bida Bin Ammar Neighborhood in Asharej District)
3	**Intensification**			
	3.3 Vertical Extension: Is a roof raising often considered as a way to increase the built density in a city where the external growth is either limited or not convenient. It allows to increase the built volume without real estate. Also, it is a valid strategy to face urban sprawl increasing density within compact cities.	3.1.1 Allowing to subdivide a large parcel of land into two or more further parcels.	Google Earth maps.	Not applied in all zones.

Table 33: Conceptual Framework of Urban Densification Tools (cont'd).

UD Tools No.	Tools of Urban Densification	Indicators	Tools of Investigation of the Application	Application in the Study Area (Bida Bin Ammar Neighborhood in Asharej District)
3	**Intensification**			
	3.4 Horizontal Extension			
	3.4.1 Increase of Bulk Rights: Bulk and massing are used internationally to control the amount of construction in a particular area.	a) Adding extra area to the house by extending current balconies (closing the current balconies).	Google Earth maps, and field observations.	Applied in zones: A, B, D, and E. Zone C is not applied.
		b) Increasing the bulk (mass) rights of a specific property by extending buildings' front and side facades, and rear extension for single-family houses.	Google Earth maps, field observations.	Applied in zones: A, C, D, and E. Zone B is not applied.
	3.4.2 Attached/ Detached Second Dwelling: The ability to build another structure on the premises where there is sufficient space on a property in order to increase the number of units on the same property.	a) Providing additional units to the existing house (either detached structures that are located in the main home's back or side yard, or attached external apartments that are sharing at least one wall with the main house).	Google Earth maps, and field observations.	Applied in zones: A, B, D, and E. Zone C is not applied.

Table 33: Conceptual Framework of Urban Densification Tools (cont'd).

UD Tools No.	Tools of Urban Densification	Indicators	Tools of Investigation of the Application	Application in the Study Area (Bida Bin Ammar Neighborhood in Asharej District)
4	**Infill Development**			
	4.1 Development of Vacant Parcels, where there is a presence of unused land within developed areas.	4.1.1 Filling the vacant places in the community.	Google Earth maps, and land-use map.	Applied in all zones.
	4.2 Demolition and Reconstruction: Demolition is "The complete removal of structure or a scope of construction (alteration, addition, renovation or reconstruction) of a structure where only the foundation of the original structure remains".	4.2.1 Providing new housing units by demolishing the old existing buildings, and replacing them by new ones to accommodate a bigger area (bigger mass).	Google Earth maps, and field observations.	Applied in all zones.

Appendix B

Table 34: Al Ain Region 2030 Demographic Forecasts (Aggressive Scenario) – Source: AACM.

	2010			2030		
	Population			Population		
	Emirati	Foreign	Total	Emirati	Foreign	Total
Al Ain region total population	**169,301**	**385,839**	**555,140**	**284,082**	**714,103**	**998,185**
Asharej	9,367	4,360	13,727	16,115	6,746	22,862
Al Dafeinah	1,157	136	1,294	1,996	211	2,207
Bida Bin Ammar	1,201	1,772	2,973	2,055	2,742	4,797
Shabhanat Asharej	1,670	1,604	3,273	2,800	2,481	5,281
Shiebat Al Oud	5,338	848	6,186	9,265	1,312	10,577
Central district	3,247	54,632	57,878	5,008	79,350	84,358
Al Ain Oaisis	-	328	328	-	87	87
Al Kuwaitat	335	8,019	8,354	560	12,436	12,995
Al Natlah	-	41	41	-	185	185
Al Nyadat	698	9,441	10,139	1,164	12,961	14,125
Al Rubainah	6	1,230	1,237	3	2,295	2,297
Al Talaa	472	4,094	4,566	804	7,912	8,716
Hai Al Hisn	5	816	821	2	1,149	1,152
Hai Al Humaira	10	4,517	4,527	16	6,195	6,212
Hai Al Madheef	15	694	709	24	2,554	2,579
Hai Al Nawase	1	1,939	1,941	0	1,763	1,764
Hai AL Salama	49	3,560	3,609	21	2,806	2,827
Hai Al Qesaidah	16	3,135	3,151	7	3,890	3,898
Nad Al Gorban	653	2,310	2,963	1,090	4,977	6,067

Figure 103: Transportation Framework: Roads – Source: (Plan Al Ain 2030, 2009).

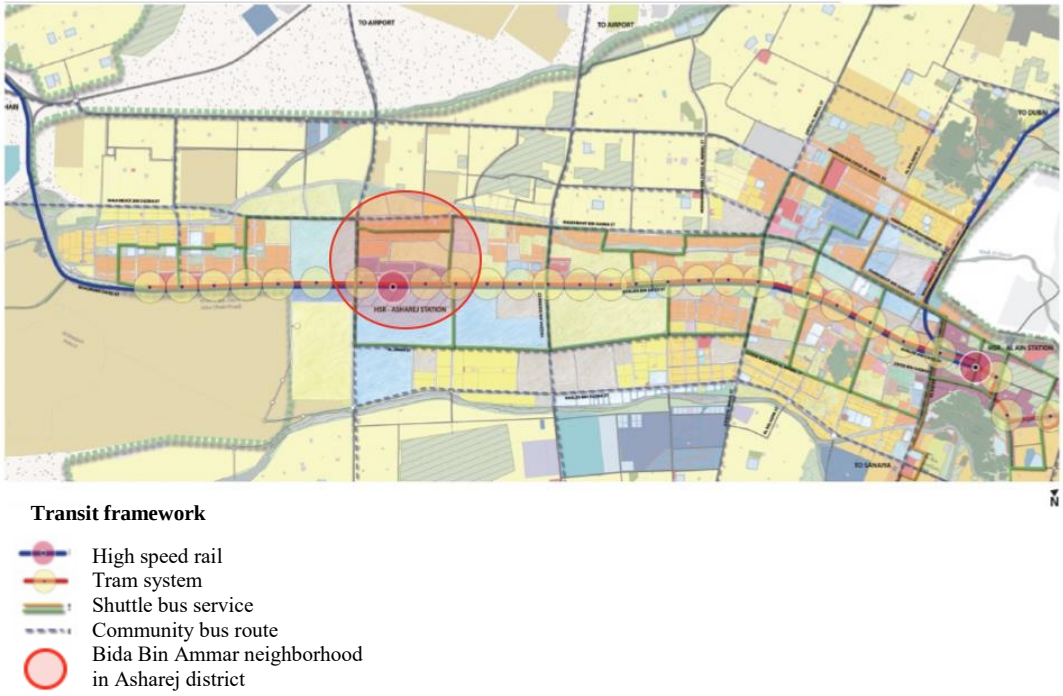

Figure 104: Transportation Framework: Transit – Source: (Plan Al Ain 2030, 2009).

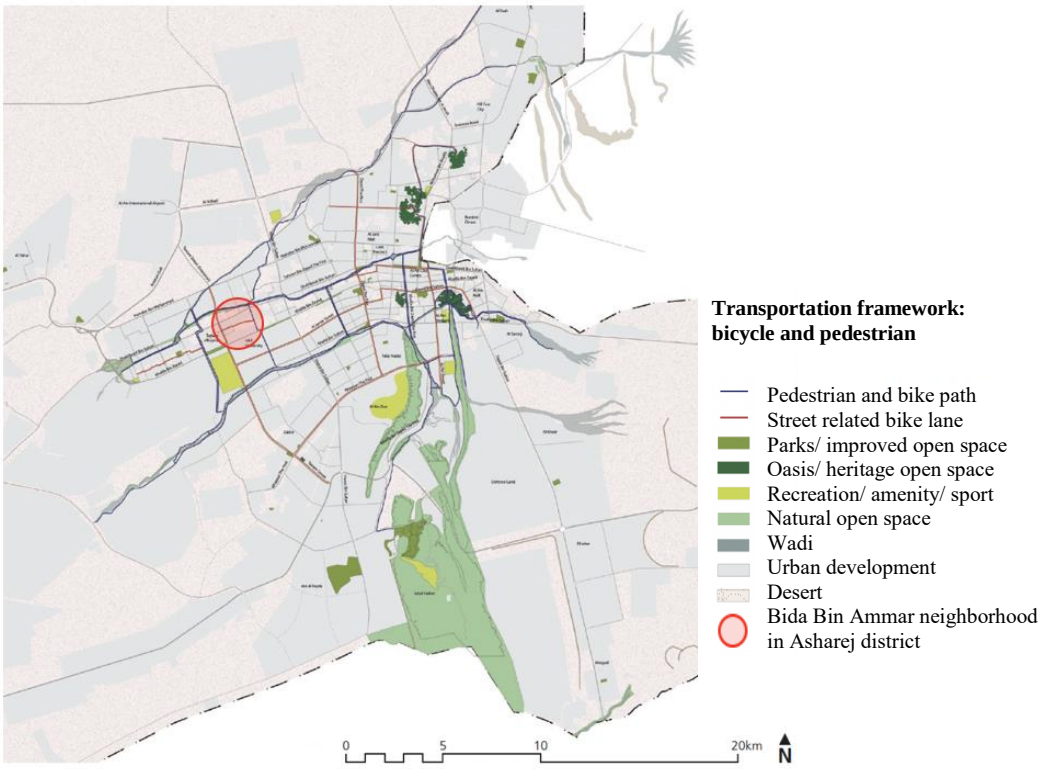

Figure 105: Pedestrian and Cycle Plan in Plan Al Ain 2030 – Source: (Plan Al Ain 2030, 2009).